



U.S. INDUSTRY MARKET LEADERSHIP IN ASIA'S AIR POLLUTION CONTROL SECTOR

January, 2001

**Prepared for US-AEP by
The McIlvaine Company, Northbrook IL**

Table of Contents

	Page
I. Executive Summary	1
II. Sources of Supply and U.S. Exports	3
III. Air Pollution Products and Services Primer	5
IV. Factors Affecting Competitiveness	17
V. Asian Markets	20
VI. Market Opportunities for U.S. Products	23
VII. U.S. Competitiveness and Market Leadership	27
Appendices	36
Endnotes	73

I. EXECUTIVE SUMMARY

Demand for air pollution control products in the Asian economies where US-AEP is active is similar to the demand seen in the U.S. in the 1960's. Infrastructure needs are driving demand higher for cement, steel, chemicals, and power. Air quality problems associated with these basic industries are substantial. They are, however, problems that have been satisfactorily addressed in the U.S. Stringent U.S. regulations and the size of the U.S. market make U.S. firms market leaders in air pollution application and product segments. Consequently, U.S. companies have the experience and capacity to capture a significant share of the Asian air quality technology and services market.

U.S. companies are highly successful at developing new products superior to those offered by competitors, and have greater experience in their application. These assets offer greater value to Asian customers, with advantages that are not offset by the geographical disadvantages of U.S. firms. Most air pollution equipment derives value from its unique design, rather than its method of fabrication. Some products, such as high performance dust collector bags, can be produced with automated equipment and delivered to Asia at a lower cost than local production. In an area where local design and fabrication is important, such as the supply of small standardized equipment, U.S. companies are already manufacturing in Asia.

The greatest necessity for air pollution control in Asian countries is coal-fired power generation. Many of these countries have indigenous coal resources, and will be greatly expanding their coal-fired power generation over the next several years. U.S. suppliers have extensive experience to offer Asian customers in the supply of electrostatic precipitators and fabric filters for coal-fired plants, and in the removal of sulfur dioxide (SO₂) through flue gas desulfurization. In addition, U.S. firms are rapidly gaining practice in the removal of nitrous oxides (NO_x). The demand for all of these technologies will grow as Asian countries develop.

Many Asian economies are moving to the next stage of development creating new pollution and air quality problems. Pollutants from surface coating industries and odors from sewage plants and food manufacturing are prime examples of new pollution problems confronting Asian countries. Two economies, Taiwan and Korea, are already addressing these issues, and in time other Asian countries will also pursue the reduction of volatile organic compounds (VOC). In addition to these stationary sources of pollution, Asian countries are finding that automobiles and mobile equipment are also generating growing amounts of smog and unhealthy urban air.

As a result of the Clean Air Act amendments of 1990, U.S. companies have developed solutions to many of the pollution problems created by these stationary and mobile sources. U.S. suppliers of catalysts, thermal oxidizers, carbon adsorbers and absorbers, are market leaders in many specific application and product segments. They are poised to expand into Asian markets, and are already engaged in building manufacturing facilities in Asia to meet the demand.

Demand for traditional particulate and acid gas removal equipment and services is already high in Asia, and will grow in the future. Demand for removal of VOCs and NO_x will grow to a substantial size in the future. U.S. companies have the expertise and capacity to compete effectively in the Asian market. US-AEP can provide pivotal assistance to these companies, by identifying new opportunities and bridging the gap between Asian customers seeking air pollution control technologies, and U.S. firms with the technologies and services that can help solve Asian air quality problems.

Chapter Descriptions:

Chapter I: A short executive summary of the contents of the report.

Chapter II: Defining U.S. and non-U.S. companies, and the benefits to the U.S. from sales of pollution control equipment in Asia, regardless of a firm's ownership.

Chapter III: A basic listing of air pollution control equipment and its uses and applications in different industrial and urban settings.

Chapter IV: A discussion of the factors that enhance U.S. competitiveness in the world's air pollution control market.

Chapter V: The current and potential demand for air pollution control products in Asian markets, in various sectors, that the U.S. can meet and supply.

Chapter VI: An in depth analysis of the market potential for specific products including precipitators, filters, scrubbers, monitoring and testing, and consulting.

Chapter VII: Discussion of the factors that make U.S. firms competitive in the Asian market, and contribute to U.S. market leadership in air quality products and services.

II. DEFINITION OF U.S. COMPANIES

As with many industries entering the global marketplace, the air pollution industry has undergone a great deal of acquisitions as well as internal growth. There is, therefore, a great deal of ambiguity in determining “what is and is not a U.S. company?.” In answering this question, it is necessary to look beyond simple classifications of air pollution control equipment and services and look at the underlying components of those systems; there are many unique applications for air pollution control equipment which require individualized solutions, creating strong niches for component manufacturers. The following is a brief description of this report’s methodology for answering this very complex question.

U.S. vs. Non U.S. Companies

The definition of U.S. companies for this report is based on payments being made to U.S. citizens. Those companies with large numbers of U.S. employees are more important than those with few U.S. employees, despite foreign ownership or control.

Several examples will illustrate the complexity of defining a U.S. company. Ownership does not necessarily determine the nationality of a company's operations. In the 1950s, Research Cottrell and Western Precipitation were two of the world’s largest air pollution control companies. In the 1970s, Envirotech and Combustion Engineering joined these two American companies in the top tier. Today none of these four companies exist as a separate entity.

European companies now own the assets of two of these companies. Hamon, with headquarters in Belgium, now owns Research Cottrell. Combustion Engineering is now part of Alstom. Envirotech is now part of a Canadian company, Marsulex. Babcock & Wilcox acquired Western Precipitation assets, which is a McDermott company. For all intents and purposes, this company is U.S. based but it is legally an offshore company.

There is a second tier of air pollution equipment suppliers. They include American firms such as Donaldson, BHA, and Thermo Instruments. Both BHA and Donaldson have manufacturing facilities in Asia. Therefore, sales in Asia by these companies will result in profits flowing back to the U.S. even though most of the manufacturing labor for the products will be in Asia.

The fact that U.S. companies are foreign owned does not necessarily reduce their positive impact on the U.S. economy. When Alstom acquired the assets of Combustion Engineering from ABB, it decided to focus all air pollution control activities for the company in Knoxville, Tennessee. It also decided to retain the large research laboratory in Windsor, Connecticut. The result is a greater return for the U.S., since Knoxville is providing engineering and support for worldwide air pollution control activities. Rather than reducing staff, Knoxville has hired a large number of new employees.

Scope of Products and Services

The impact of an air pollution control system sale in Asia can be far reaching. Sales of dust control systems and acid gas removal systems include large quantities of purchased products. Alstom, Durr, Environmental Elements, Wheelabrator, and most large system suppliers are primarily engineering firms who manufacture little of what they furnish. They purchase fans, motors, material handling systems, steel structures, vessels, pumps, valves, piping and instrumentation from suppliers. For every full time employee in the air pollution system company, there are 3-4 full time employees in the component companies working to supply the needs of the system company.

U.S. pumps, fans, nozzles and other items are typically utilized when the systems are designed in the U.S. System suppliers generally do not even furnish the steel or plastic housings of scrubber collectors. Steel fabricators construct these housings and can also supply similar housings for many non-air pollution applications. But several manufacturers, for example PSP, specialize just in air pollution housings. They have an Asian fabrication facility as well as several in the U.S.

Revenue also flows to U.S. suppliers of filter media roll goods. National Nonwovens, Lantor, and others supply roll goods to filter bag manufacturers such as BHA and MFRI. MFRI has automated bag-making facilities in the U.S. and can compete with local sewing operations in Asia for the following reasons: 1) they have better quality control where quality is critical; 2) they can deliver large orders quickly; and 3) their level of automation allows them to compete on price.

On the whole there is a greater impact on U.S. wages from the sale of components than from the sale of the systems. Fortunately, U.S. designed systems typically use U.S. components. To the extent these components can be sold to Asian based suppliers or to European suppliers selling into the US-AEP targeted Asian economies, the market for air pollution control is expanded.

III. AIR POLLUTION PRODUCTS AND SERVICES PRIMER

Air pollution equipment can be broadly segmented into particulate control from stationary sources, gas treatment from stationary sources, mobile treatment, monitoring and testing, and consulting services. Figure III-1 shows the broad segmentation of the industry. Figures III-2 through III-6 show a more detailed breakdown.

Particulate Control

Particulate control can be divided into electrostatic precipitation, filtration, centrifugal separation, and scrubbing (Figure III-2). Electrostatic precipitators are devices that impart a charge to particles by means of discharge electrodes. The collection plate of opposite polarity then collects the particles. The means of separating the particles from the collection plate provides a further segmentation

Dry electrostatic precipitators utilize rapping to dislodge the dust from the collection plate. Wet electrostatic precipitators wash the dust from the plate. Dry precipitators are utilized where dusts are not sticky. Wet precipitators are used for sticky dusts and for the collection of liquid aerosols. Dry precipitators are widely used for capture of emissions from coal-fired boilers, cement kilns, and many other combustion applications. Wet precipitators are used for acid mist removal from smelters, sewage sludge incinerators and more recently for wood products.

A further segmentation of precipitators is made between high voltage and low voltage precipitators. The previously mentioned applications all require high voltage collectors. Less expensive low voltage collectors are used to capture oil mists in machining operations. The 3-wok rule in Hong Kong has generated a market for low voltage precipitators in restaurants. The 3-wok rule requires the owner of a restaurant with 3 or more woks to install air pollution equipment such as electrostatic precipitators.

A second major segment of particulate control is filtration. Membranes, woven, and non-woven materials are utilized to capture dust while the clean air passes through the fabric. This group is referred to as Fabric Filters or baghouses. Segmentation by cleaning method is popular. Pulse jet filters utilize a back pulse of compressed air to periodically clean the filter tubes or cartridges. Reverse air filters use a larger volume of low-pressure air. Shaker collectors use a shaking mechanism to dislodge the dust cake.

Reverse air and shaker units were previously the choice for coal-fired boilers. Now pulse jet units are increasingly utilized. Pulse jet units have become the cleaning mechanism of choice for many applications.

Fabric filters are used for thousands of applications from grain dust to waste incinerator emissions. In the food industry the units serve to capture product as well as to prevent air pollution. Fabric Filters are the equipment of choice for many of the heavy industries expanding in Asian countries. Fabric filters are used to capture metal dust from steel

industry electric arc furnaces, dust from foundry cleaning and sand handling operations, and emissions from mining operations.

Figure III-1. Air Pollution Equipment and Services

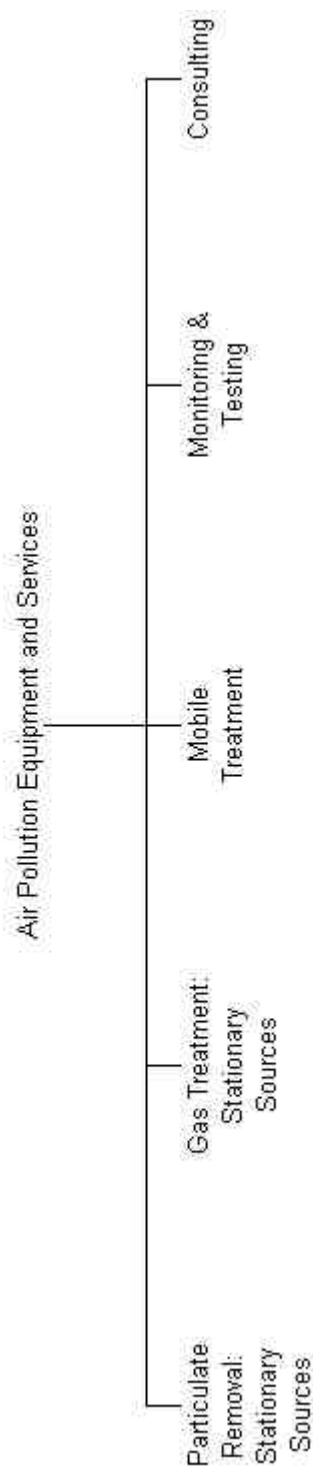
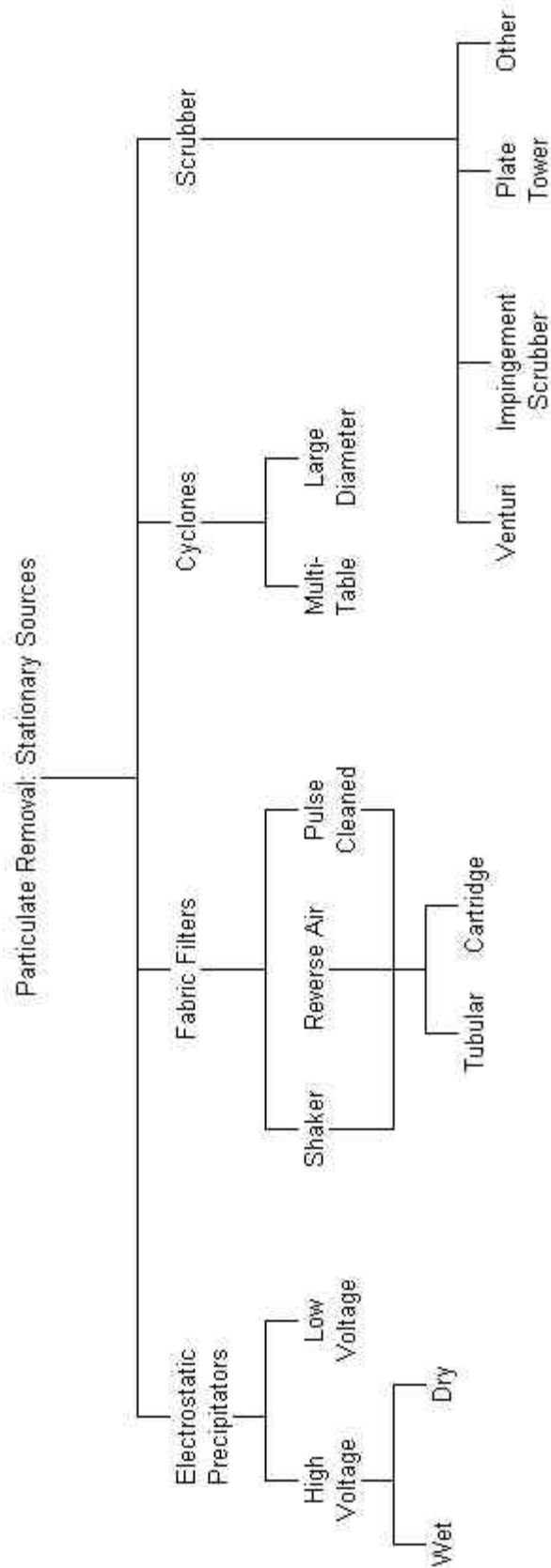


Figure III-2. Particulate Removal: Stationary Source



Centrifugal separation is the principle used in cyclones to separate the dust from the air. Large diameter cyclones are used to remove particles from woodworking operations. However, these collectors are not efficient on small particles. Small diameter cyclones (multi tube cyclones) are more efficient but do not remove sub micron particles. Therefore cyclones are often used for preliminary collection and are followed by a fabric filter or electrostatic precipitator.

Scrubbing particulate from the air emulates the action of a washing machine. The efficiency of removal is a function of the energy employed. Venturi scrubbers operating at high velocity and high-energy consumption can remove sub micron particles. Spray towers remove only larger particles but require low amounts of energy.

Scrubbers are used to capture explosive dusts, sticky dusts, and liquid aerosols. They are relatively inexpensive and are therefore very practical for many applications in developing countries. Scrubbers often serve both to remove particulate and gases thereby serving a dual purpose.

Gas Treatment

Noxious gases can be removed from air by the following means: absorption, adsorption, condensation, oxidation and reduction (Figure III-3).

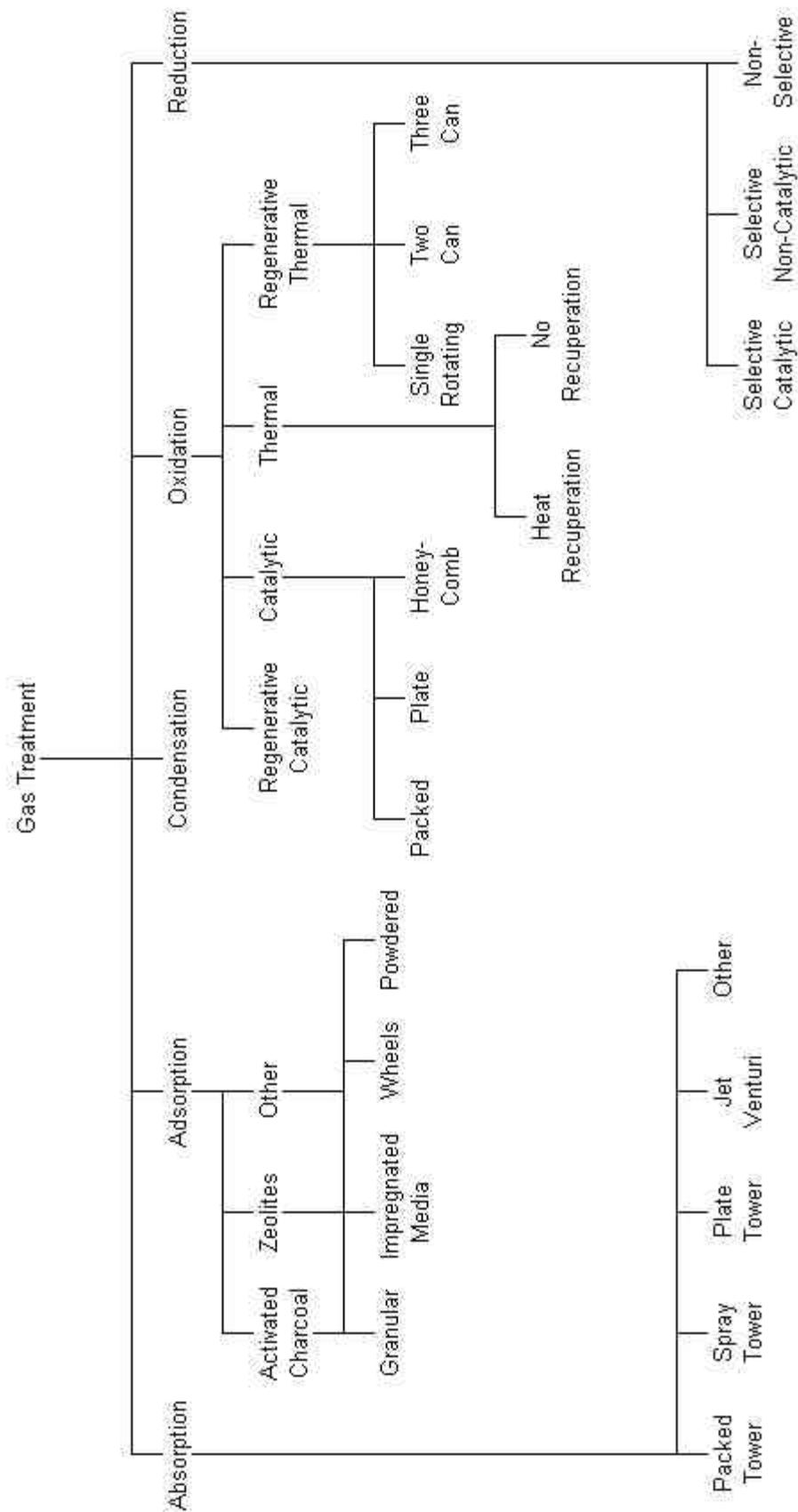
Absorbers create a reaction zone in which gas phase contaminants are exposed to a liquid. This liquid is often a slurry (lime) or a base solution (sodium). The gas reacts with the liquid to form compounds in the liquid such as sodium sulfate. Absorbers remove acid gases, odors, and many other gas contaminants.

Absorbers come in many configurations. Packed towers are very common. Upflowing gas contacts the down flowing liquid in a section packed with ceramic or plastic saddles or other structures. Plate towers are another variation. Impingement scrubbers and venturi scrubbers used for dust removal are also often used for absorption.

Adsorption does not rely on a chemical reaction. Instead, gas contaminants are adsorbed in the interstices of media, which has large surface area per unit volume. Activated carbon fills this role nicely because it is relatively inexpensive and is very porous. Zeolites also have these properties. The printing industry uses adsorbers to recover solvents. The semiconductor industry uses adsorbers to capture emissions from wafer cleaning. Cooking odors can be reduced with adsorbers.

Condensation is a way to covert gases to liquids. Cooling is the primary mechanism. Once the contaminant is in liquid droplet form it can be separated. Organic vapors are condensed and reused in production processes. Where solvent loadings are high, condensation has advantages over activated carbon adsorption.

Figure III-3. Gas Treatment



Oxidation is the conversion of a gas contaminant to an oxide such as conversion of organic gases to carbon dioxide and water vapor. Combustion is the most popular form of oxidation. Thermal incinerators or oxidizers simply combust the gas. The combustion temperature can be greatly reduced if the right catalyst is present. Catalytic oxidizers are therefore considered when the fuel content of the gas is low. Regenerative thermal oxidizers (RTO) involve the capture of the heat of oxidation. This is another approach to minimizing auxiliary fuel costs.

Oxidation is used to combust toxic gases such as dioxins as well as many organic solvent fumes. Can coating, printing, chemical processing, and semiconductor manufacturing are among the industries utilizing this technology.

Reduction

Selective catalytic reduction (SCR) is similar to catalytic oxidation except that the catalyst in the presence of ammonia or urea causes a reaction of NO_x forming N_2 and water vapor. The same reaction can be accomplished at very high temperatures without the presence of a catalyst. When ammonia or urea is simply injected into the top of a furnace the process is called Selective non-catalytic reduction (SNCR). SCR and SNCR are being applied to most large coal-fired generation plants in Western Europe and Japan. A large initiative to install them in the U.S. is underway. Industrial boilers, gas turbines, waste incinerators and nitric acid plants also utilize these technologies.

Mobile Treatment

Automobiles, trucks, and other mobile equipment discharge carbon monoxide, volatile organics, and nitrous oxide. Catalytic reactors, a smaller version of the industrial counterpart, are therefore used to oxidize and reduce emissions (Figure III-4).

The mobile sector is a longer term opportunity in Asia and the market is served by a small number of large companies. This is due to the fact that the purchasers are the large automobile manufacturers who buy in large quantity. Because of this, opportunities for the majority of U.S. companies in the mobile sector are less than in other sectors.

Monitoring and Testing

Emissions must be quantified. Equipment to measure emissions discharged from stationary sources differs from that used to measure ambient emissions. The reason is that the pollutant quantities differ greatly. Typically ambient equipment measure parts per billion whereas stack measurement equipment measures parts per million (Figure III-5).

Another segmentation relates to the length of testing. Continuous emissions monitors operate 24 hours per day. Intermittent sampling equipment is typically used to perform a 2-3 hour test. Whereas continuous emissions monitors operate automatically, the intermittent

equipment requires an operator. This has created a whole industry of testing firms. Many of the samples they collect must then be transferred to a laboratory for analysis.

Figure III-4. Mobile Treatment

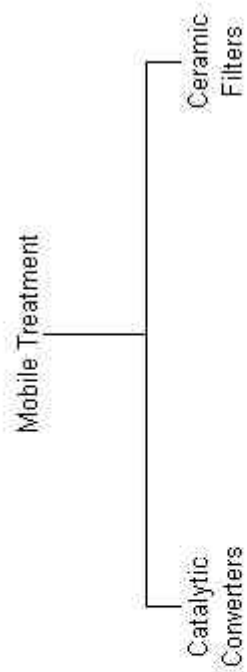
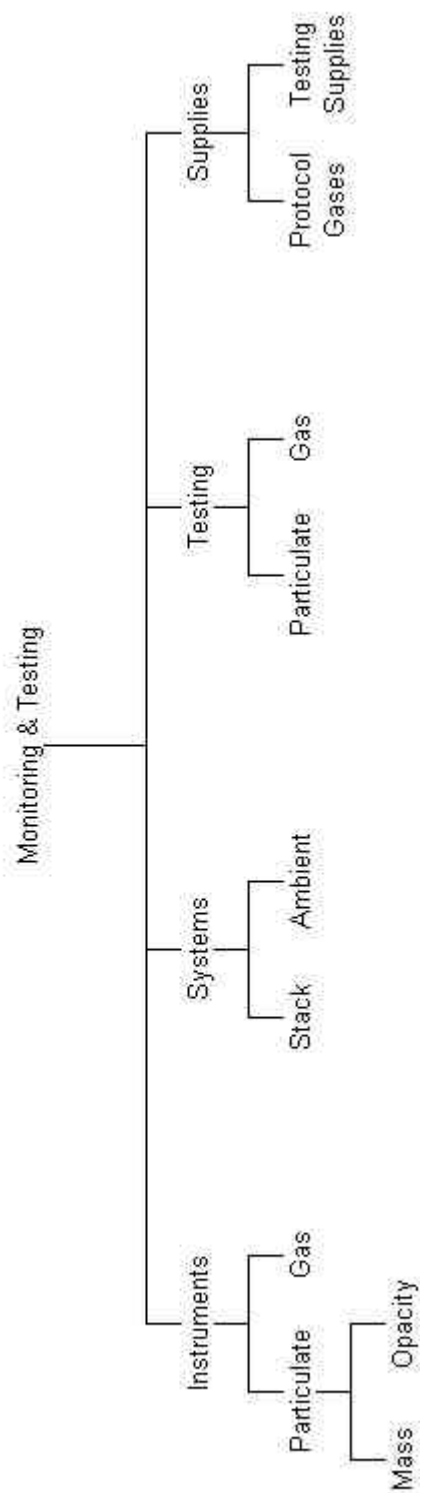


Figure III-5. Monitoring & Testing



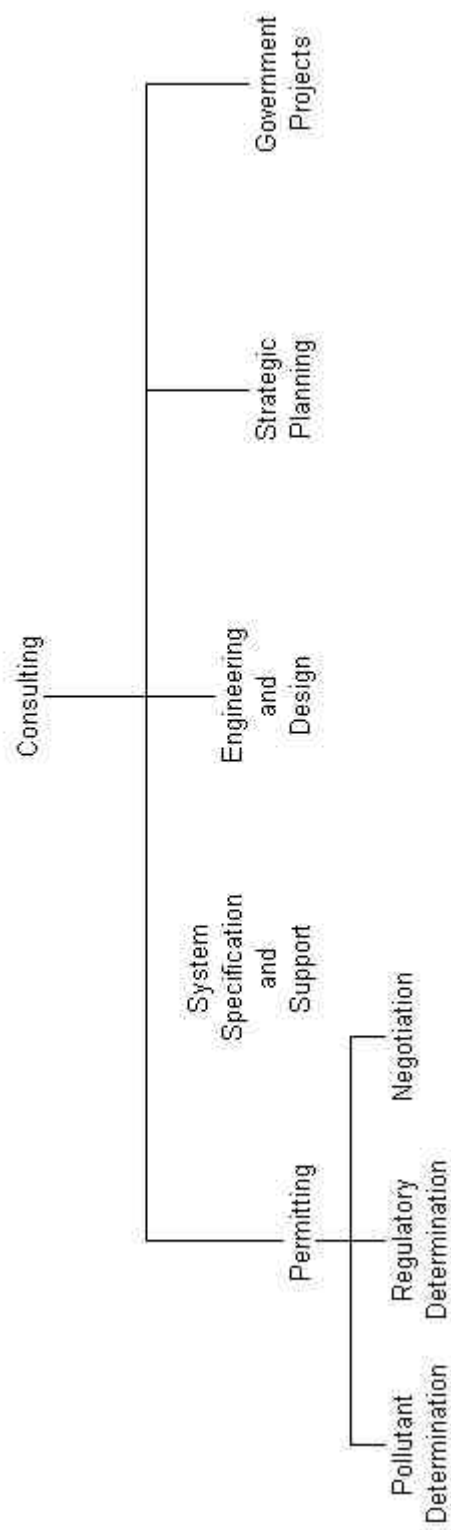
A continuous emissions measuring system has a number of components including the pollutant sensors (and there could be one for each pollutant), a sample extraction system, a conditioning system, and finally a data acquisition and reporting system.

Continuous emissions monitors are typically found on large stacks with substantial potential to pollute. Small operations generally utilize periodic stack sampling.

Consulting Services

Advice and assistance are needed at all levels of air pollution control (Figure III-6). Initial investigation is needed to determine what regulations are applicable and the present level of emissions from the source. Next the best solution must be determined. The successful contractor must then supply engineering and construction services. Some consultants specialize just in permitting and regulatory aspects of air pollution. Others focus on engineered solutions; some provide the full range of services.

Figure III-6. Consulting



IV. FACTORS AFFECTING COMPETITIVENESS

There are a number of factors affecting the competitiveness of U.S. firms in the world air pollution market. In order of importance they are:

Stringency of U.S. Regulations

The history of the air pollution control industry in the U.S. clearly demonstrates that the more stringent U.S. regulations are, the stronger U.S. suppliers will be in the world market. U.S. suppliers were the largest in the world in the 1950s and 1960s. When the U.S. passed regulations requiring SO₂ scrubbing on coal-fired boilers in 1970, U.S. suppliers quickly became the world leaders in scrubbing technology. But when most plants escaped the regulatory net because of a grandfather clause, lack of strong regulations undermined the position in the U.S. and world markets. Japanese and European companies with strong local markets quickly gained ascendancy and a dominant position in world markets.

The U.S. is once again on center stage with a huge scrubber retrofit program underway. Even though many of the suppliers are headquartered offshore, the U.S. will again become the center of engineering, technology, and research for SO₂ scrubbing.

The trend in electrostatic precipitator market shares clearly shows the same relationship between stringency of regulations and world success. The U.S. firms Research Cottrell and Western Precipitation were the world leaders in the supply of electrostatic precipitators until Europe and Japan instituted tougher standards. By the time U.S. EPA instituted the same standards, only the offshore companies had the experience to supply the equipment. Subsequently, both U.S. leaders became subsidiaries of other companies. Alstom, FLS, and Lab, all European companies, have carved out a major market share, with Alstom now being the U.S. and world market leader.

Research and Development

The second most important factor in determining competitiveness is in research and development. When an engineer at Mikropul developed a method of using compressed air to pulse clean dust collector bags instead of shaking them, he created a whole new industry. Mikropul soon had other U.S. competitors, but it took many years for this technology to be acquired by offshore companies. As a result, even though the original invention took place in the 1950s, U.S. companies still dominate the world pulse jet filter industry.

The development of air pollution instrumentation has taken a similar path. Thermo Environmental, the largest air pollution instrumentation company in the world, has built its empire on the homegrown developments of its researchers and those of acquired companies.

Most of the success has come from private research and development. In contrast the relatively large amount of funding of R&D by the U.S. government has not been as productive. For example, a large amount of government money was spent to develop dry

injection technology for SO₂ removal. This is a low efficiency alternative to wet and spray dryer technologies and is not likely to have commercial popularity.

Size and Strength of Domestic Companies

Well-run U.S. companies are proving that the transition from domestic to global strength is highly feasible. Donaldson works with small sized dust collectors and, after dominating the U.S. market, has become the world leader in this niche. The company is highly profitable and has set up manufacturing facilities in India to allow better, more efficient access to Asian markets. It has avoided the temptation to compete in the market for big, engineered collectors. The result is that it has dust collector sales of over \$140 million year and is more profitable than companies in the large engineered collector segment.

Engelhard has followed the same philosophy in the supply of catalysts. It is not competing in the large coal-fired boiler market, but is the world market leader in catalysts for many industrial applications and in the supply of catalysts to the automotive industry.

Market Leadership

A U.S. company does not have to be big or highly capitalized but it does have to be a market leader. Knowledge is the key to success in many segments of air pollution control. A small company that concentrates on acquiring knowledge and expertise in a narrow area can become the market leader in the U.S, and transfer their leadership to the global marketplace. Knowledge is the most economically exported commodity.

Anderson 2000 became the market leader in the narrow field of scrubbing waste incinerator gases. Even when shipping complete scrubbers from the Southern U.S, they garnered a large share of the South East Asia market. Anderson picked a niche too small to interest Alstom and the other large scrubber suppliers. As a result, Anderson developed expertise for this particular application superior to the larger companies and, by concentrating on South East Asia, combined market knowledge with application knowledge, which yielded profitable results.

Financial Strength

This factor ranks fairly low on the list since most air pollution control equipment is not manufactured in facilities owned by the supplier. Instead smaller steel and plastic fabrication shops accomplish the actual manufacturing. As a result it requires little initial capital investment to start an air pollution control business. Furthermore it is relatively easy to compete in Asia by contracting with an Asian fabricator to build equipment from drawings furnished by the U.S. supplier.

There are some exceptions to this generalization. Small collectors are more economically manufactured in one location rather than job shopped. That is why Donaldson set up an Indian manufacturing facility. Donaldson's high profitability is due in part to the fact that

the suppliers of large collectors cannot possibly supply small collectors at the same costs Donaldson achieves in its own manufacturing facilities.

Conventional Factors Affecting Competitiveness

All the conventional factors affecting competitiveness also apply in air pollution control. Product cost is obviously important. Products shipped from the U.S. to Asia are, in general, at a competitive disadvantage. The cost of U.S. labor is also a negative factor. Nevertheless, these two cost factors are not a serious limitation on access to Asian air pollution control markets. Manufacture or assembly in Asia avoids the high cost of shipment of products and high U.S. labor costs. In many cases, the amount of U.S. labor involved in a standard product, designed in the U.S. and built in Asia, is minimal. In the case of a \$200,000 scrubber, the U.S. labor may only be reproducing and mailing drawings to an Asian contractor.

But there are also many instances where air pollution control products made in the U.S., and shipped to Asia, are still competitive. For example, MFRI sews glass bags for Asian electric furnace applications in its U.S. plant. Its large, automated operation allows it to quote short delivery times and supply orders that small Asian bagmakers cannot handle. The high cost of U.S. labor is addressed through its investment in automation. Very little labor is involved in MFRI sewing operations.

V. ASIAN DEMAND

The Asian economies which are covered by this report -Hong Kong SAR, India, Indonesia, Malaysia, Philippines, Singapore, South Korea, Sri Lanka, Taiwan, Thailand, and Vietnam-range from developing to developed. Taiwan and South Korea have made great progress. Their higher standard of living has brought with it concern about the environment and the means and the will to reduce air pollution. The mountainous terrain in both economies traps pollutants in the low areas and makes the solution more difficult.

Vietnam, Indonesia, and others in the group are still lacking basic infrastructure. Therefore, the need for steel, cement, and other basic materials is substantial. The region has rebounded from the financial crisis that peaked two years ago. Therefore, economic growth should be healthy in the region over the next few years.

Figure V-1 is a forecast for the year 2001 for three of the largest market segments: electrostatic precipitators, flue gas desulfurization, and fabric filters. India is the most populous of the 11 economies. It is addressing its environmental problems and is making some progress. However, its expenditures for flue gas desulfurization are less than those in South Korea. Its fabric filter expenditures this year will only be slightly higher than South Korea.

Figure V-1. Air Pollution Markets 2001

	Electrostatic Precipitators		FGD (Power Plant)		Fabric Filter System	
	\$ mil	% of world	\$ mil	% of world	\$ mil	% of world
Hong Kong	5	0.2%	20	0.4%	8	0.2%
India	138	5.1%	150	3.3%	100	3.1%
Indonesia	26	1.0%	75	1.7%	38	1.2%
Malaysia	37	1.4%	25	0.6%	12	0.4%
Phillipines	31	1.1%	90	2.0%	14	0.4%
Singapore	2	0.1%	10	0.2%	5	0.2%
South Korea	63	2.3%	225	5.0%	91	2.8%
Sri Lanka	2	0.1%		0.0%	3	0.1%
Taiwan	52	1.9%	150	3.3%	34	1.0%
Thailand	28	1.0%	90	2.0%	25	0.8%
Vietnam	6	0.2%	75	1.7%	5	0.2%
TOTAL	389	14.4%	910	20.2%	335	10.3%
East Asia	1,163	43.0%		0.0%	1,041	31.9%
West Asia	160	5.9%		0.0%	124	3.8%
Asia	1,324	48.9%	1,350	30.0%	1,165	35.7%
World	2,704	100.0%	4,500	100.0%	3,266	100.0%

These 11 economies will purchase 14.4% of the world supply of precipitators, 20% of the FGD systems and 10% of the fabric filters. Fabric filters and precipitators are needed for reasons other than air pollution control. Without them the parking lots of steel and cement mills would fill with dust. The high percentage of the flue gas desulfurization, though, is due to an environmental commitment. Vietnam has a much higher rate of SO₂ reduction than does the United States. It recently installed FGD on its first big coal-fired plant. South Korea placed the world's largest order for FGD several years ago when it purchased scrubbers for nearly 9,000 MW of coal-fired power plants.

Asia will purchase 49% of the precipitators this year compared to 36% of the fabric filters and 30% of the FGD systems. The reason for the high Asian percentage of precipitators is the commitment to construct large numbers of coal-fired power plants.

Asian Analysis by Equipment Type

Figure V-2 compares the Asian (less China and Japan) and World markets in 2001. Note that when it comes to less essential air pollution control, this Asian sub-segment is a small factor in the world market. In all the categories except precipitators and fabric filters, the Asian sub-segment share is less than 15%. In the case of mobile equipment, it is only 8%. This early emphasis on dust control with subsequent attention to gaseous pollutants has been typical of all the industrialized countries. Even as late as the 1960s most air pollution control equipment sold in the U.S. was to remove visible dust.

Figure IV-2. Asian* Air Pollution Markets 2001

	World \$ mil	Asia* \$ mil	% of world
Air Monitoring Instruments	1,229	135.2	11%
Air Monitoring Systems	1,152	126.7	11%
Catalytic Oxidizers	522	41.8	8%
Fabric Filter System	3,266	587.9	18%
FGD (Power Plant)	4,500	630.0	14%
Mobile	3,000	240.0	8%
NOx Reduction	3,700	222.0	6%
Precipitators	2,704	405.6	15%
RTO (Regenerative Thermal Oxidizer)	1,113	100.2	9%
Scrubber/Adsorber	5,424	596.6	11%
Supplies (Monitoring)	430	38.7	9%
Testing	1,634	163.4	10%
Thermal Oxidizer	555	50.0	9%

* Less China and Japan

The Asian sub-segment will spend more on FGD systems (\$630 million) this year than on any other pollution control segment. FGD typically utilizes scrubbers but is such a large segment that it is treated separately. Regenerative thermal, thermal, and catalytic oxidizers represent a market of \$192 million.

The market for monitoring instruments, systems, testing, and supplies is also large. Combined it is a market of \$464 million in the eleven economies. Monitoring and testing is needed prior to equipment installation. Therefore it is not surprising that more will be spent on monitoring and testing in 2001 than on either NO_x reduction or mobile treatment (catalytic converters and traps).

VI. MARKETS AND PENETRATION FOR SPECIFIC PRODUCTS

Electrostatic Precipitators

Forecasts that are based on contractor revenuesⁱ are smaller than the numbers presented in Figures V-1 and V-2, which are based on system revenues. The difference is that precipitator suppliers do not always obtain contracts for the complete systems. The customer may hire his own contractor to install the systems. India and Sri Lanka are grouped in the West Asia sub segment whereas the other nine economies are included in the East Asia sub segment.

Detailed forecasts for both wet and dry precipitatorsⁱⁱ show that power is the largest application, followed by cement. One exception is Indonesia where pulp and paper is the largest market.

India is the largest purchaser among the 11 economies but its \$85 million investment this year will pale in comparison to the \$417 million which will be spent in China. China is not only the largest precipitator market it is the largest supplier of precipitators in the world. Forty percent of the world's cement is manufactured in China. China is installing more coal-fired boilers than all of Europe. Therefore, the domestic precipitator market is very large. About 20% of the precipitators (mostly sold with complete plants), are supplied by offshore companies. This is likely to change and China will become a net exporter of precipitators. As a result, the 11 economies in this study will become prime markets for China, thus creating competition for U.S. companies.

Alstom is very successful in Asia and has many precipitators installed in the 11 subject economies. The Knoxville U.S. office is involved in some of this activity. But much of it is also local or from Europe. FLS is another precipitator leader in Asia. Very little of this activity is from Texas. Most is from Europe or is local. Environmental Elements has made some penetration of the pulp mill market in Indonesia with its precipitators. Hamon Research Cottrell is active in Asia. Most of the revenue is attributable to the U.S. company although local licensees and agents are also involved. Korea Cottrell is a very successful Korean-based licensee. It is active throughout the region.

Smaller precipitator suppliers such as Croll Reynolds, Beltran, Belco, and Geo Energy have not made major inroads into the 11-economy market. Assistance is needed by many of the smaller parts suppliers such as Analytec, which furnishes sonic horns to clean the internals of the precipitator. Neundorfer is a supplier of rappers to dislodge the dust.

Fabric Filters

The 11 economies will spend \$335 million for fabric filter systems this yearⁱⁱⁱ. There is a market for bags as well as equipment. MFRI is effectively competing in Asia with shipments from its automated facilities in the U.S. The bag market is only 50% as large as the equipment market but is often more profitable.

U.S. equipment suppliers are modestly successful in Asia. Donaldson is well positioned throughout the region. Wheelabrator has a strong licensee in Japan. Mikropul, which is now part of Beacon, was originally a U.S. company subsequently purchased by the Japanese licensee and now purchased by another American company.

There are a large number of U.S. fabric filter equipment suppliers who are doing little if any business in the 11 subject economies.

Scrubbers and Adsorbers

For the Asian market, the chemical industry is the largest application^{iv}. Absorption is the largest type. The 2001 Asian market for absorbers is \$849 million followed by \$330 million for adsorbers and \$239 million for particulate scrubbers.

There are hundreds of U.S. companies supplying scrubbers and adsorbers. Few have penetrated the 11 subject economies. One exception is Anderson 2000 who has successfully sold incinerator scrubber systems into Malaysia, Indonesia, and other South East Asia economies.

Calgon Carbon is one of the world's leading suppliers of activated charcoal for air pollution adsorption. However, Chinese suppliers are not only competing effectively in Asia but are undercutting the prices in the U.S. as well.

Flue Gas Desulfurization

Asia will spend \$1.35 billion for FGD systems this year. Most new coal-fired boilers constructed in the region will be equipped with FGD, while in the U.S. the primary market is retrofitting older generators. In Asia, the main market is new power generators. Because the individual orders are large, forecasts^v are based on average annual purchases rather than for specific years. By 2006 Asia will be raising its annual investment in new systems to \$2 billion.

Alstom is a major supplier of FGD systems. Babcock & Wilcox has also been a significant supplier in the region. U.S. companies have done well in Taiwan and Korea in spite of stiff competition from Japan and Europe. The huge retrofit FGD market in the U.S. is going to challenge the U.S. companies to meet the domestic demand. This will decrease their Asian market share in the short run. But longer term, the financial and technical strengths garnered in the U.S. can then be leveraged in Asia.

Spraying Systems, Koch, and other U.S. suppliers of FGD components have significant opportunities in Asia. U.S. components have proven more reliable than those furnished by local Taiwan companies. Some specifications force the use of U.S. or European components by requiring demonstrated performance over many years. This eliminates the less experienced Asian suppliers.

Thermal Treatment

Electronics is one of the larger markets for thermal treatment in Asia. The total RTO (see Chapter III: Gas Treatment) market this year will be \$313 million. More than 20% will be for incineration of solvent fumes from wafer cleaning operations. The chemical industry will be the next largest purchaser^{vi}. Miscellaneous applications are the biggest segment of the straight thermal treatment market. Surface coating is the largest application for catalytic oxidizers. The 2001 sales in Asia will be \$141 million. Surface coating will account for \$30 million of that total.

There are many U.S. based suppliers of thermal treatment equipment. Monsanto Envirochem, and Engelhard are already active in the subject countries. Smaller suppliers such as Anguil, Met Pro and CSM have made some inroads. This will be an attractive market because of the substantial market growth in Asia.

NO_x Control

Twenty-one percent of the \$3.7 billion NO_x market will be in Asia this year. This percentage will grow steadily over the next decade and offer major market opportunities for U.S. suppliers. Smaller companies such as Fuel Tech have already availed themselves of US-AEP assistance and have had some success in the market. Their niche is SNCR (see Chapter III: Reduction), which represents only a fraction of the opportunity of SCR (see Chapter III: Reduction), but nevertheless will account for sales of \$410 million this year^{vii}.

Since most coal-fired boilers are being installed without SCR, there will be a growing retrofit potential in Asia. This offers opportunities to component suppliers as well as system suppliers. Suppliers of catalysts are primarily non-U.S. companies since Engelhard has not pursued the coal-fired boiler applications. System suppliers include Peerless, Hamon Research Cottrell, Alstom, B & W and Babcock Borsig, all with major facilities for design in the U.S. There are some novel technologies such as Xonon from Catalytica and SCONOX from Goal Line, which hold promise. There are also suppliers of ammonia injection systems and other components who are U.S. based.

Monitoring and Testing

This is a large market served by a multitude of small companies. One exception is Thermo Environmental that has made significant penetration with its instruments into the Asian market. Since testing according to U.S. EPA test methods is required in many of the 11 economies, U.S. instrument suppliers have an advantage. It is expensive to have instruments certified in the U.S. Therefore; unless a company is competing in the U.S. market it would not obtain U.S. certification.

The market for continuous monitoring systems in Asia grew from \$204 million in 1996 to a projected \$321 million in 2001^{viii}. The market for testing will be \$428 million this year. But this is very labor intensive and is therefore confined to local offices. A number of U.S.

consulting firms also done some stack testing but most do not have stack-testing services in Asia.

Entropy, Clean Air Engineering, and MECO do some stack testing through travel from the U.S., but this is mostly for multi national companies who have utilized their services in the U.S.

Consulting

U.S. consulting firms have made some penetration into the 11 economies. Many have offices in Singapore or Sydney and also local offices in other major cities. Much of their work is for governments and multi national companies. Washington Group, Black & Veatch, Sargent and Lundy, ERM, and Bechtel are all established in the area. There are a number of consulting niches that are being served by small companies^{ix}. One example would be an expert on electric furnace fume exhaust. He regularly advises Korean steel companies on this specific application.

There are a number of niche experts in the U.S. who could provide considerable aid to Asian companies. By in large this expertise is not being applied. There are many failures in developing countries due to the lack of niche expertise. General consulting firms by definition do not have niche experts. Thanks to modern communications, niche expertise can, in some cases, be delivered by means other than personal visits, thereby greatly reducing the cost and making participation from the U.S. viable.

Mobile

Johnson Matthey of the U.K. and Engelhard of the U.S. are major players in the world automotive catalyst market. Engelhard has sales in the mobile area of over \$500 million. Last year it sold 1,800 catalytic converters to Hong Kong's largest bus operator. It has started up a new manufacturing plant in India. Johnson Matthey has constructed new plants in India.

Growth in the mobile segment will be substantial. The severe ozone problem in many of the major cities in the 11 economies will be the driving force behind standards that will eventually require catalytic converters.

VII. U.S. COMPETITIVENESS AND MARKET LEADERSHIP

The U.S. is the world's largest market for air pollution control equipment, technology, and services. Since R &D and product design are the main assets of market leaders, the most competitive companies are those who can spread their R&D and design costs over the largest possible revenue potential. Therefore U.S. companies have a big advantage over suppliers in any other country of the world and they have capitalized on their good fortune. There are now more U.S. companies who are market leaders, in various product and application niches worldwide, than from any other country.

Market leadership and competitiveness are complimentary terms. A market leader achieves the status by being more competitive than others. To maintain market leadership they must maintain this competitiveness. Because R&D and design, rather than manufacturing costs, are the largest factor in competitiveness, a market leader in the U.S. can easily become a leader in Asia. U.S. companies can easily find Asian partners to perform the actual equipment fabrication without fear that it will be creating a future competitor. It is also true that the local fabrication can be cost competitive with an Asian company that owns its own fabrication facilities.

There are more than 1000 U.S. companies who are market leaders in air pollution niches in the U.S. with the potential to be very competitive in Asian economies. Figure VII-1 is an alphabetical listing of more than 100 market leadership positions. Some companies such as Alstom are market leaders in specific industries (power) for a number of products. Other companies such as Smith are market leaders in specific products (thermal oxidizers) for a number of industries.

The market leader ranking indicates that the company is among the top suppliers. A ranking of 3 indicates that the company is one of the top 3 suppliers, defined in terms of revenues averaged over the last 3 years, in the specific niche. It should be emphasized that there are more than 10,000 market leadership positions. So this list of 100 is only representative of the much larger leadership position of a number of U.S. firms. Many companies are market leaders in 10 or more categories.

Market Leadership Positions Explanations

The 1990 Clean Air Act amendments toughened the laws for destruction of hazardous organic compounds and other volatile organic compounds enabling companies offering **thermal destruction** equipment to prosper.

- ABB Air Preheater (now part of Alstom) is a market leader in 2 types of thermal destruction in 5 industries.
- Alstom as the worlds largest air pollution company is a market leader in the power sector for nearly every type of equipment.
- Babcock Borsig, Babcock & Wilcox, Marsulex, and Wheelabrator all compete with Alstom and have market leadership positions in the power industry.

- In contrast, Amerex is a leader only in pulse jet filters and the steel industry. Amcec, Anguil, CSM, Epcon, Stealth and Applied Web have also carved out market leadership positions in thermal destruction.
 - Durr, Monsanto Envirochem, Megtec and Smith are examples of larger companies that have gained leadership positions in many applications using thermal destruction techniques.
-

Catalysts are also employed to enhance thermal destruction.

- Engelhard and Johnson Matthey are market leaders in industrial catalysts as well as in mobile catalysts. Both these companies are building new Asian plants to make them competitive in this region.
-

Adsorption or scrubbing are alternatives to destruction of organics.

- BOC Edwards, U.S. Filter Calgon Carbon, and Ceco are leaders in these alternative technologies.
 - Anderson 2000 is a market leader in scrubbing emissions from industrial incinerators and has proved its competitiveness in Asia.
-

Wet precipitators are used to capture liquid aerosols.

- Beltran and GeoEnergy are market leaders in several application niches using this technology.
-

- Clarcor and Trion are market leaders in two stage **dry low voltage precipitators** used in restaurants, metalworking and other applications where greasy fumes are emitted.
-

- The U.S. is now a huge market for NO_x reduction. Foster Wheeler joins Babcock Borsig, Babcock & Wilcox, and Alstom to account for most of the **SCR systems** now being installed in the U.S.
-

Many **FGD systems** will also be installed in the coming years in the U.S. All the new coal-fired power plants in Asia should be installing FGD.

- Marsulex and the other power oriented air pollution companies will be strong competitors in Asia in the future. Marsulex has already supplied the first FGD system in Vietnam.
-

- Many of the biggest innovations in **fabric filtration** have come from U.S. companies, such as the pulse jet filter from Mikropul, and the cartridge from Donaldson, now the largest worldwide supplier of fabric filters.
 - Bags are the key component of fabric filters. BHA and MFRI are world leaders who can ship competitively into Asia from U.S. facilities. W.L. Gore is a world leader in applications where high temperatures and high efficiency are needed.
-

- There are many U.S. component suppliers who are not only domestic market leaders but also can ship competitively into Asia or arrange for local production. Analytec and BHA are **sonic horn** leaders.
 - Effox is a major supplier of **dampers**. Koch and Munters have captured most of the **mist eliminator** market.
 - Neuendorfer leads in **precipitator rappers** whereas NWL leads in the **precipitator transformer** category.
-

The U.S. is the world leader in **air monitoring instrumentation**.

- Thermo Environmental Instruments is the #1 supplier worldwide and has made substantial penetration into Asia.
 - A number of other U.S. suppliers are competitive in Asia because of the adoption of U.S. certification standards since only companies whose instruments are certified in the U.S. can supply instruments to these countries as well.
-

Finally, in the area of **environmental consulting**, U.S. firms have expertise gained in the U.S. market that makes their services attractive to Asian governmental agencies and to industry. There are few European counterparts to the U.S. consultant, and Japan has little strength in this area. Asians, of necessity, must turn to the U.S. for experienced consultants.

Figure VII-1. Market Leadership Positions of Companies with Major U.S. Operations

Company	SIC	Industry Description	Application	Product	Market Leader Ranking				City	St
					World	Europe	Asia	North Amer.		
1 ABB Air Preheater	2000	Food processing	odors	thermal				5	Wellsville	NY
2 ABB Air Preheater	2700	Printing	solvent	thermal				3	Wellsville	NY
3 ABB Air Preheater	2891	Adhesives	solvent	thermal				3	Wellsville	NY
4 ABB Air Preheater	2891	Adhesives	solvent	regenerative thermal oxidizer				3	Wellsville	NY
5 ABB Air Preheater	4953	Municipal waste	incineration	regenerative thermal oxidizer				2	Wellsville	NY
6 Alstom	4911	Utility	pc boiler	dry precipitator	1	1	4	1	Knoxville	TN
7 Alstom	All	All	all	dry precipitator	1	1	4	1	Knoxville	TN
8 Alstom	4911	Utility	cfb boiler	dry precipitator	1	1	4	1	Knoxville	TN
9 Alstom	3240	Cement	kiln	dry precipitator	2	2	5	2	Knoxville	TN
10 Alstom	4911	Utility	pc boiler	FGD	1	5	5	1	Knoxville	TN
11 Alstom	4911	Utility	pc boiler	selective catalytic reduction	3	2		2	Knoxville	TN
12 Amcec	2700	Printing	solvent	adsorber	5			2	Lisle	IL
13 Amerex	3312	Steel	arc furnace	pulse jet				3	Kennesaw	GA
14 Analytec	All	All	all	sonic horn				2	Pagosa Springs	CO
15 Anderson 2000	4953	Municipal waste	combustor	scrubber	5	5	4	3	Peachtree City	GA
16 Andrews	All	All	all	needle felt	2	2		2	Milwaukee	WI
17 Anguil	2700	Printing	solvent	catalytic				3	Milwaukee	WI
18 Anguil	4953	Soil remediation	combustor	catalytic				1	Milwaukee	WI
19 Applied Web Systems	2700	Printing	solvent	catalytic				3	Elgin	IL
20 Applied Web Systems	2700	Printing	solvent	thermal				3	Elgin	IL
21 ATMI	3674	Semiconductor	POU	scrubber	2			2	San Jose	CA
22 Babcock Borsig	4911	Utility	pc boiler	selective catalytic reduction	5	3		3	Worcester	MA
23 Beltran	2200	Textile	tenter frm	wet precipitator	5		5	1	Brooklyn	NY

Figure VII-1. Market Leadership Positions of Companies with Major U.S. Operations (Cont'd)

Company	SIC	Industry Description	Application	Product	Market Leader Ranking				City	St
					World	Europe	Asia	North Amer.		
24 Beltran	3331	Copper smelter	H2SO4 mist	wet precipitator	5			3	Brooklyn	NY
25 BHA	All	All	all	sonic horn	5			2	Kansas City	MO
26 BHA	All	All	all	bags	1	3	3	1	Kansas City	MO
27 Bigelow-Liptak	2900	Petroleum refining	VOCs	thermal				2	Watertown	NY
28 BOC Edwards	3674	Semiconductor	POU	scrubber	2			2	Wilmington	MA
29 CAE	All	All	all	stack test	5			1	Palatine	IL
30 Calgon Carbon	All	All	all	activated carbon	2			1	Pittsburgh	PA
31 Calgon Carbon	All	All	all	solvent recovery	5	3		3	Pittsburgh	PA
32 Calgon Carbon	4952	Sewerage systems	odors	adsorber	2	2		2	Pittsburgh	PA
33 Ceco	2000	Food processing	ammonium nitrate	mist eliminator	2			2	Conshohocken	PA
34 Ceco	All	All	all	ductwork				1	Conshohocken	PA
35 Chemical Lime	All	All	all	lime	2	2		2	Montevallo	AL
36 Clarcor	3340	Metal smelting	oil mist	2 stage precipitator	2			1	Rockville	IL
37 Clean Gas	1000	Iron mining	pellet plant	scrubber	5			2	Ronkonkoma	NY
38 Cormetech	4911	Utility	pc boiler	selective catalytic reduction	5			2	Durham	NC
39 Croll Reynolds	4952	Sewerage systems	sewage sludge	wet precipitator				2	Westfield	NJ
40 Croll Reynolds	2800	Chemical	acid gas	scrubber	5			2	Westfield	NJ
41 CSM	2050	Bakeries	VOCs	catalytic				3	Mountainside	NJ
42 Donaldson	All	All	all	small fabric filter	1	1	1	1	Minneapolis	MN
43 Donaldson	3400	Metalworking	welding	small fabric filter	1	1	1	1	Minneapolis	MN
44 Donaldson	3400	Metalworking	CNC mist	cartridge filter	1			1	Minneapolis	MN
45 Dravo Lime	All	All	all	lime	2	2		2	Pittsburgh	PA
46 Duall	3400	Metalworking	plating	scrubber	5			2	Owosso	MI
47 Durr	2000	Food processing	odors	regenerative thermal oxidizer				3	Owosso	MI

Figure VII-1. Market Leadership Positions of Companies with Major U.S. Operations (Cont'd)

Company	SIC	Industry Description	Application	Product	Market Leader Ranking				City	St
					World	Europe	Asia	North Amer.		
48Durr	3674	Semiconductor	solvent	thermal				3	Wixom	MI
49Durr	3710	Motor vehicles	mobile	thermal	1	1		1	Wixom	MI
50Durr	3710	Motor vehicles	mobile	regenerative thermal oxidizer	1	1		1	Wixom	MI
51Effox	4911	Utility	pc boiler	selective catalytic reduction damper	3			1	Cincinnati	OH
52Engelhard	3710	Motor vehicles	mobile	auto catalysts	2	2	3	1	Edison	NJ
53Engelhard	2800	Chemical	organics	catalysts				2	Edison	NJ
54Engelhard	2830	Pharmaceuticals	organics	catalysts				2	Edison	NJ
55Environmental Elements	2600	Pulp & paper	rec furnace	dry precipitator	3	5	5	1	Baltimore	MD
56Environmental Elements	4911	Utility	pc boiler	dry precipitator				5	Baltimore	MD
57Environmental Elements	4911	Utility	pc boiler	urea system				2	Baltimore	MD
58Epcon Ind. Systems	2000	Food processing	odors	thermal				5	The Woodlands	TX
59Epcon Ind. Systems	2500	Furniture	organics	thermal				5	The Woodlands	TX
60Flex Kleen	3341	Aluminum smelter	pot line	pulse jet	5			2	Itasca	IL
61Foster Wheeler	4911	Utility	pc boiler	selective catalytic reduction				5	Clinton	NJ
62Fueltech	4911	Utility	pc boiler	selective non-catalytic reduction	1	1	1	1	Batavia	IL
63Fuller (FLS)	3240	Cement	kiln	reverse air fabric filter	2	2	2	2	Bethlehem	PA
64GeoEnergy	2400	Wood products	synthetic wood	wet precipitator				2	Kent	WA
65GeoEnergy	4952	Sewerage systems	sewage sludge	wet precipitator				2	Kent	WA
66GeoEnergy	2400	Forest products	sheetboard	regenerative thermal oxidizer				3	Kent	WA
67Goyen	All	All	all	pulse jet valve	1	2	2	1	Lakewood	NJ
68Griffin	3270	Concrete	batch	pulse jet filter				2	Syracuse	NY

Figure VII-1. Market Leadership Positions of Companies with Major U.S. Operations (Cont'd)

Rank	Company	SIC	Industry Description	Application	Product	Market Leader Ranking				City	St
						World	Europe	Asia	North Amer.		
69	Hamon Research Cottrell	4911	Utility	pc boiler	dry precipitator		5		3	Somerville	NJ
70	Hamon Research Cottrell	2911	Refineries	catalytic cracker	dry precipitator	5	5		3	Somerville	NJ
71	Hamon Research Cottrell	4911	Utility	pc boiler	urea system				2	Somerville	NJ
72	Howden	All	All	all	fans	1	1	1	1	Hyde Park	MA
73	ITEQ	4953	Municipal waste	hazardous waste incineration	wet precipitator		5		2	Houston	TX
74	ITEQ	2800	Chemical	chemical processing	wet precipitator	1	1		1	Houston	TX
75	Johnson Matthey	3710	Motor vehicles	mobile	auto catalysts	2	1	3	2	Wayne	PA
76	Johnson Matthey	2800	Chemical	organic fumes	catalysts				2	Wayne	PA
77	Johnson Matthey	2830	Pharmaceuticals	organic fumes	catalysts				2	Wayne	PA
78	Koch	4911	Utility	pc boiler	ammonia				1	Louisville	KY
79	Koch	4911	Utility	pc boiler	mist eliminator	2	2		2	Louisville	KY
80	KWH	4953	Municipal waste	dioxin	catalyst	1	1			Yonkers	NY
81	KWH	4911	Utility	pc boiler	catalyst	5	1		4	Yonkers	NY
82	Lab	4953	Municipal waste	combustor	wet precipitator	1	1	1	1	Parsippany	NJ
83	Lantor	All	All	all	needle felt	2	2		2	Bellingham	MA
84	Marsulex	4911	Utility	pc boiler	FGD-ammonia				1	Lebanon	PA
85	Marsulex	2900	Petroleum refining	catalytic cracker	cyclones				2	Lebanon	PA
86	Megtec	2000	Food processing	odors	regenerative thermal oxidizer				3	DePere	WI
87	Megtec	2700	Printing	solvent	catalytic				2	Lebanon	PA
88	MFRI	All	All	all	bags	3			2	Niles	IL
89	Mikropul	2800	Chemical	pulverizer	pulse jet	1	1	1	1	Summit	NJ
90	Monsanto	All	All	all	wet scrubber	3	3	5	1	Chesterfield	NJ
91	Monsanto	All	All	all	biofilter	1	1		1	Chesterfield	NJ
92	Monsanto	2000	Fertilizers	ammonia nitrate	mist eliminator	2	2		2	Chesterfield	NJ
93	Munters	4911	Utility	pc boiler	mist eliminator	2	2		2	Fort Myers	FL

Figure VII-1. Market Leadership Positions of Companies with Major U.S. Operations (Cont'd)

Company	SIC	Industry Description	Application	Product	Market Leader Ranking				City	St
					World	Europe	Asia	North Amer.		
94Munters	3674	Semiconductor	wafer clean	rotary concentrator				3	Fort Myers	FL
95Neuendorfer	All	All	all	rappers	5			2	Willoughby	OH
96NWL	All	All	all	transformers	2			1	Bordentown	NJ
97Peerless	All	Industrial	gas turbine	selective catalytic reduction				3	Dallas	TX
98Pneumafil	2200	Textile	textile dust	rotary				1	Charlotte	NC
99Process Combustion Corp.	2000	Food processing	odors	catalytic				5	Pittsburgh	PA
100Process Combustion Corp.	2800	Chemical	organics	thermal				3	Pittsburgh	PA
101Prototech	2000	Food processing	odors	catalysts				5	Needham	MA
102Prototech	2800	Chemical	organics	catalysts				3	Needham	MA
103Prototech	2830	Pharmaceuticals	organics	catalysts				3	Needham	MA
104Purafil	4952	Sewerage systems	chlorine leak	dry scrubber	3			1	Oconomowac	WI
105Senior Flex	All	All	all	expansion joints	1	1	1	1	New Braunfels	TX
106Smith	2400	Forest products	sheetboard	regenerative thermal oxidizer				3	Ontario	CA
107Stealth Industries	3300	Metal Industries	organics	catalytic				5	Anaheim	CA
108Stealth Industries	3300	Metal Industries	organics	thermal				5	Anaheim	CA
109Stealth Industries	4953	Municipal waste	incineration	catalytic				3	Anaheim	CA
110Stealth Industries	4953	Municipal waste	incineration	thermal				3	Anaheim	CA
111Thermatrix	4953	Municipal waste	incineration	regenerative thermal oxidizer				3	San Jose	CA
112Thermo In	All	All	all	air analyzer	1	1	1	1	Franklin	MA
113Trion	3340	Metal products	oil mist	2 stage precipitator	2			2	Sanford	NC
114US Filter	4952	Sewerage systems	odors	scrubber	1			1	Palm Desert	CA
115US Filter	4952	Sewerage systems	odors	carbon	3			3	Palm Desert	CA
116US Filter	2900	Petroleum refining	H2S	scrubber	1			1	Palm Desert	CA

Figure VII-1. Market Leadership Positions of Companies with Major U.S. Operations (Cont'd)

Company	SIC	Industry Description	Application	Product	Market Leader Ranking				City	St
					World	Europe	Asia	North Amer.		
117 W.L. Gore	4953	Municipal waste	hazardous waste incineration	membrane bags	1			1	Elkton	MD
118 W.L. Gore	3240	Cement	kiln	membrane bags	1	2	2	1	Elkton	MD
119 Wheelabrator	4953	Municipal waste	combustor	dry precipitator				2	Pittsburgh	PA
120 Wheelabrator	3312	Steel	arc furnace	pulse jet filter				3	Pittsburgh	PA
121 Wheelabrator	4953	Municipal waste	combustor	reverse air fabric filter				1	Pittsburgh	PA

APPENDICES

FIGURE I-7 Precipitators (Wet & Dry) by Location Totals - \$ millions

<u>COUNTRY</u>	1999	2000	2001	2002	2003
Algeria	\$0.60	\$0.62	\$0.65	\$0.67	\$0.70
Egypt	\$4.73	\$4.94	\$5.17	\$5.43	\$5.73
Kenya	\$0.36	\$0.39	\$0.42	\$0.45	\$0.50
Libya	\$0.20	\$0.21	\$0.21	\$0.22	\$0.22
Morocco	\$6.72	\$6.90	\$7.09	\$7.29	\$7.51
Nigeria	\$1.07	\$1.19	\$1.32	\$1.48	\$1.66
Other Africa	\$2.51	\$2.53	\$2.55	\$2.58	\$2.60
South Africa	\$18.98	\$19.24	\$19.54	\$19.87	\$20.26
Tunisia	\$0.58	\$0.60	\$0.62	\$0.64	\$0.66
TOTAL:Africa	\$35.76	\$36.61	\$37.56	\$38.63	\$39.84
Belarus	\$0.44	\$0.45	\$0.45	\$3.31	\$3.32
Kazakhstan	\$6.14	\$6.18	\$6.21	\$6.27	\$6.31
Other CIS	\$2.28	\$2.36	\$2.46	\$2.55	\$2.69
Russia	\$36.61	\$36.76	\$36.92	\$37.08	\$37.24
Ukraine	\$10.18	\$10.26	\$10.35	\$10.44	\$10.53
Uzbekistan	\$0.46	\$0.49	\$0.52	\$0.56	\$0.60
TOTAL:CIS	\$56.11	\$56.49	\$56.91	\$60.21	\$60.69
Australia	\$29.59	\$29.97	\$30.36	\$30.75	\$31.15
China	\$396.88	\$407.00	\$417.82	\$429.45	\$441.9
Hong Kong	\$2.58	\$2.67	\$2.78	\$2.90	\$3.04
Indonesia	\$14.23	\$14.98	\$15.79	\$16.68	\$17.65
Japan	\$110.50	\$113.00	\$115.54	\$118.11	\$120.7
Malaysia	\$21.90	\$22.24	\$22.58	\$22.93	\$23.29
New Zealand	\$0.58	\$0.59	\$0.61	\$0.62	\$0.64
Other East Asia	\$0.41	\$0.44	\$0.48	\$0.52	\$0.56
Philippines	\$18.39	\$18.76	\$19.16	\$19.60	\$20.08
Singapore	\$0.62	\$0.68	\$0.74	\$0.81	\$0.89
South Korea	\$36.68	\$37.89	\$39.20	\$40.64	\$42.22

FIGURE I-7 Precipitators (Wet & Dry) by Location Totals - \$ millions

<u>COUNTRY</u>	1999	2000	2001	2002	2003
Taiwan	\$31.21	\$31.74	\$32.30	\$11.28	\$11.65
Thailand	\$16.27	\$16.71	\$17.17	\$17.68	\$18.22
Vietnam	\$3.44	\$3.54	\$3.66	\$3.78	\$3.92
TOTAL:East Asia	\$683.28	\$700.20	\$718.18	\$715.75	\$736.0
Bulgaria	\$6.27	\$6.36	\$6.45	\$6.55	\$6.65
Czech Republic	\$6.22	\$6.32	\$6.44	\$6.58	\$6.74
Hungary	\$1.86	\$6.03	\$6.23	\$6.46	\$6.70
Other Eastern Europe	\$7.85	\$8.04	\$8.23	\$8.44	\$8.66
Poland	\$24.88	\$25.29	\$25.74	\$26.25	\$26.81
Romania	\$9.44	\$9.61	\$9.79	\$11.19	\$11.44
Slovakia	\$3.04	\$3.09	\$3.14	\$3.19	\$3.25
TOTAL:Eastern Europe	\$59.56	\$64.74	\$66.03	\$68.66	\$70.25
Iran	\$1.88	\$1.95	\$2.02	\$2.09	\$2.16
Iraq	\$0.37	\$0.41	\$0.45	\$0.51	\$0.57
Israel	\$9.01	\$9.12	\$9.24	\$9.36	\$9.48
Other Middle East	\$1.17	\$1.30	\$1.44	\$1.61	\$1.81
Saudi Arabia	\$1.18	\$1.20	\$1.22	\$1.24	\$1.26
Syrian Arab Republic	\$0.96	\$1.02	\$1.09	\$1.16	\$1.24
United Arab Emirates	\$0.36	\$0.36	\$0.37	\$0.37	\$0.38
TOTAL:Middle East	\$14.93	\$15.37	\$15.83	\$16.34	\$16.90
Canada	\$53.17	\$54.34	\$55.55	\$56.79	\$58.06
Mexico	\$12.50	\$12.94	\$13.43	\$13.92	\$14.46
United States	\$208.83	\$250.39	\$283.87	\$326.27	\$329.3
TOTAL:NAFTA	\$274.49	\$317.66	\$352.84	\$396.97	\$401.9

FIGURE I-7 Precipitators (Wet & Dry) by Location Totals - \$ millions

<u>COUNTRY</u>	1999	2000	2001	2002	2003
Argentina	\$2.35	\$2.49	\$2.64	\$2.79	\$2.96
Brazil	\$33.27	\$35.75	\$38.51	\$41.59	\$45.03
Chile	\$6.11	\$6.46	\$6.87	\$7.28	\$7.75
Colombia	\$4.31	\$4.50	\$4.69	\$4.93	\$5.19
Ecuador	\$0.26	\$0.27	\$0.28	\$0.29	\$0.30
Guatemala	\$0.28	\$0.31	\$0.33	\$0.37	\$0.40
Other South & Central America	\$2.05	\$2.22	\$2.42	\$2.65	\$2.91
Peru	\$1.50	\$1.63	\$1.76	\$1.92	\$2.09
Venezuela	\$2.16	\$2.28	\$2.41	\$2.55	\$2.71
TOTAL:South & Central America	\$54.70	\$58.39	\$62.47	\$67.00	\$72.07
Bangladesh	\$0.97	\$1.03	\$1.10	\$1.17	\$1.24
India	\$80.51	\$82.80	\$85.34	\$88.16	\$91.32
Myanmar	\$0.47	\$0.53	\$0.59	\$0.67	\$0.76
Other West Asia	\$0.24	\$0.27	\$0.30	\$0.33	\$0.38
Pakistan	\$10.36	\$10.76	\$11.20	\$11.71	\$12.30
Sri Lanka	\$0.54	\$0.57	\$0.61	\$0.65	\$0.70
TOTAL:West Asia	\$93.10	\$95.96	\$99.14	\$102.70	\$106.7
Austria	\$2.66	\$2.68	\$2.71	\$2.74	\$2.76
Belgium	\$3.14	\$3.96	\$4.03	\$4.10	\$4.18
Denmark	\$1.64	\$1.64	\$1.63	\$1.63	\$1.62
Finland	\$12.03	\$16.60	\$16.91	\$17.26	\$17.59
France	\$23.76	\$24.29	\$24.84	\$25.40	\$25.98
Germany	\$57.76	\$71.65	\$72.42	\$73.21	\$74.02
Greece	\$8.47	\$8.62	\$8.78	\$8.93	\$9.10
Ireland	\$1.40	\$1.43	\$1.47	\$1.50	\$1.54
Italy	\$23.55	\$24.03	\$24.55	\$25.06	\$25.61

FIGURE I-7 Precipitators (Wet & Dry) by Location Totals - \$ millions

<u>COUNTRY</u>	1999	2000	2001	2002	2003
Netherlands	\$5.43	\$5.52	\$5.62	\$5.72	\$5.83
Norway	\$0.99	\$1.01	\$1.03	\$1.06	\$1.08
Other Western Europe	\$0.40	\$0.40	\$0.41	\$0.41	\$0.41
Portugal	\$2.19	\$2.28	\$2.37	\$2.47	\$2.58
Spain	\$22.32	\$20.45	\$20.95	\$21.47	\$22.01
Sweden	\$15.33	\$15.76	\$16.20	\$16.66	\$17.13
Switzerland	\$1.38	\$1.40	\$1.43	\$1.45	\$1.48
Turkey	\$22.22	\$25.25	\$25.97	\$26.72	\$27.50
United Kingdom	\$30.59	\$30.87	\$31.16	\$31.45	\$31.75
TOTAL:Western Europe	\$235.27	\$257.87	\$262.49	\$267.25	\$272.1
ALL COUNTRY TOTAL:	\$1,507.18	\$1,603.28	\$1,671.4	\$1,733.52	\$1,776

Fabric Filter Industry Forecast (by country)

East Asia

Hong Kong

(\$ millions)	1999	2000	2001	2002	2003
<u>Bags</u>					
<u>Chemical</u>	\$0.28	\$0.30	\$0.32	\$0.34	\$0.37
<u>Food & Grain</u>	\$0.22	\$0.24	\$0.25	\$0.27	\$0.30
<u>Foundries</u>	\$0.08	\$0.08	\$0.08	\$0.08	\$0.09
<u>Metals & Metal Working</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Mining</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Miscellaneous</u>	\$0.77	\$0.83	\$0.89	\$0.95	\$1.02
<u>Pharmaceutical</u>	\$0.15	\$0.16	\$0.17	\$0.19	\$0.20
<u>Power</u>	\$0.25	\$0.26	\$0.28	\$0.29	\$0.31
<u>Pulp & Paper / Wood Products</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Steel</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Stone-Cement</u>	\$0.11	\$0.11	\$0.12	\$0.13	\$0.13
<u>Waste Incinerators</u>	\$0.02	\$0.03	\$0.04	\$0.04	\$0.05
Bags total:	\$1.88	\$2.01	\$2.15	\$2.30	\$2.46

Equipment

<u>Chemical</u>	\$0.52	\$0.56	\$0.60	\$0.64	\$0.69
<u>Food & Grain</u>	\$0.36	\$0.39	\$0.42	\$0.46	\$0.49
<u>Foundries</u>	\$0.14	\$0.14	\$0.14	\$0.15	\$0.15
<u>Metals & Metal Working</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Mining</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Miscellaneous</u>	\$1.26	\$1.35	\$1.44	\$1.55	\$1.66
<u>Pharmaceutical</u>	\$0.24	\$0.26	\$0.28	\$0.30	\$0.32
<u>Power</u>	\$0.34	\$0.34	\$0.36	\$0.38	\$0.38
<u>Pulp & Paper / Wood Products</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Steel</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Stone-Cement</u>	\$0.16	\$0.17	\$0.18	\$0.19	\$0.20
<u>Waste Incinerators</u>	\$0.14	\$0.17	\$0.20	\$0.25	\$0.30
Equipment total:	\$3.15	\$3.37	\$3.63	\$3.92	\$4.20

Systems

<u>Chemical</u>	\$1.15	\$1.23	\$1.32	\$1.41	\$1.51
<u>Food & Grain</u>	\$0.80	\$0.86	\$0.93	\$1.01	\$1.09
<u>Foundries</u>	\$0.30	\$0.31	\$0.32	\$0.32	\$0.33

Fabric Filter Industry Forecast (by country)

East Asia

Hong Kong

	(\$ millions)	1999	2000	2001	2002	2003
<u>Metals & Metal Working</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Mining</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Miscellaneous</u>		\$2.77	\$2.96	\$3.18	\$3.41	\$3.65
<u>Pharmaceutical</u>		\$0.53	\$0.57	\$0.61	\$0.66	\$0.71
<u>Power</u>		\$0.74	\$0.74	\$0.79	\$0.84	\$0.84
<u>Pulp & Paper / Wood Products</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Steel</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Stone-Cement</u>		\$0.36	\$0.38	\$0.40	\$0.42	\$0.44
<u>Waste Incinerators</u>		\$0.30	\$0.37	\$0.45	\$0.55	\$0.67
Systems total:		\$6.93	\$7.41	\$7.99	\$8.62	\$9.25
Bags total:		\$1.88	\$2.01	\$2.15	\$2.30	\$2.46
Equipment total:		\$3.15	\$3.37	\$3.63	\$3.92	\$4.20
System total:					\$6.93	\$7.41
					\$8.62	\$9.25

Fabric Filter Industry Forecast (by country)

East Asia

Indonesia

	(\$ millions)	1999	2000	2001	2002	2003
<u>Bags</u>						
<u>Chemical</u>		\$0.51	\$0.55	\$0.59	\$0.64	\$0.69
<u>Food & Grain</u>		\$1.03	\$1.11	\$1.20	\$1.29	\$1.40
<u>Foundries</u>		\$0.38	\$0.39	\$0.40	\$0.41	\$0.43
<u>Metals & Metal Working</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Mining</u>		\$0.29	\$0.30	\$0.31	\$0.32	\$0.34
<u>Miscellaneous</u>		\$3.77	\$3.88	\$4.00	\$4.12	\$4.24
<u>Pharmaceutical</u>		\$0.71	\$0.77	\$0.83	\$0.89	\$0.96
<u>Power</u>		\$0.25	\$0.26	\$0.27	\$0.29	\$0.30
<u>Pulp & Paper / Wood Products</u>		\$0.55	\$0.61	\$0.67	\$0.73	\$0.81
<u>Steel</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Stone-Cement</u>		\$1.63	\$1.71	\$1.80	\$1.89	\$1.98
<u>Waste Incinerators</u>		\$0.16	\$0.19	\$0.22	\$0.26	\$0.31
Bags total:		\$9.28	\$9.77	\$10.29	\$10.85	\$11.45

Equipment

<u>Chemical</u>	\$0.95	\$1.03	\$1.11	\$1.20	\$1.30
<u>Food & Grain</u>	\$1.71	\$1.85	\$2.00	\$2.16	\$2.33
<u>Foundries</u>	\$0.66	\$0.68	\$0.70	\$0.72	\$0.74
<u>Metals & Metal Working</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Mining</u>	\$0.48	\$0.50	\$0.52	\$0.53	\$0.55
<u>Miscellaneous</u>	\$6.13	\$6.31	\$6.50	\$6.70	\$6.90
<u>Pharmaceutical</u>	\$1.15	\$1.24	\$1.34	\$1.45	\$1.57
<u>Power</u>	\$0.34	\$0.34	\$0.36	\$0.36	\$0.36
<u>Pulp & Paper / Wood Products</u>	\$0.90	\$0.98	\$1.08	\$1.19	\$1.31
<u>Steel</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Stone-Cement</u>	\$2.44	\$2.57	\$2.69	\$2.83	\$2.97
<u>Waste Incinerators</u>	\$0.71	\$0.83	\$0.97	\$1.13	\$1.32
Equipment total:	\$15.47	\$16.32	\$17.27	\$18.27	\$19.35

Systems

<u>Chemical</u>	\$2.10	\$2.26	\$2.44	\$2.64	\$2.85
<u>Food & Grain</u>	\$3.76	\$4.06	\$4.39	\$4.74	\$5.12
<u>Foundries</u>	\$1.46	\$1.50	\$1.54	\$1.58	\$1.63

Fabric Filter Industry Forecast (by country)

East Asia

Indonesia

(\$ millions)	1999	2000	2001	2002	2003
<u>Metals & Metal Working</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Mining</u>	\$1.05	\$1.09	\$1.13	\$1.18	\$1.22
<u>Miscellaneous</u>	\$13.48	\$13.88	\$14.30	\$14.73	\$15.17
<u>Pharmaceutical</u>	\$2.53	\$2.74	\$2.95	\$3.19	\$3.45
<u>Power</u>	\$0.74	\$0.74	\$0.79	\$0.79	\$0.79
<u>Pulp & Paper / Wood Products</u>	\$1.97	\$2.17	\$2.38	\$2.62	\$2.88
<u>Steel</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Stone-Cement</u>	\$5.38	\$5.65	\$5.93	\$6.23	\$6.54
<u>Waste Incinerators</u>	\$1.55	\$1.82	\$2.13	\$2.49	\$2.91
Systems total:	\$34.02	\$35.91	\$37.99	\$40.19	\$42.56
Bags total:	\$9.28	\$9.77	\$10.29	\$10.85	\$11.45
Equipment total:	\$15.47	\$16.32	\$17.27	\$18.27	\$19.35
System total:	\$34.02	\$35.91	\$37.99	\$40.19	\$42.56

Fabric Filter Industry Forecast (by country)

East Asia

Japan

	(\$ millions)	1999	2000	2001	2002	2003
<u>Bags</u>						
Chemical		\$15.14	\$15.79	\$16.47	\$17.18	\$17.92
Food & Grain		\$4.27	\$4.61	\$4.98	\$5.38	\$5.81
Foundries		\$2.06	\$2.12	\$2.18	\$2.24	\$2.30
Metals & Metal Working		\$7.12	\$7.26	\$7.41	\$7.56	\$7.71
Mining		\$1.04	\$1.05	\$1.05	\$1.06	\$1.06
Miscellaneous		\$15.62	\$16.04	\$16.47	\$16.92	\$17.37
Pharmaceutical		\$5.75	\$6.21	\$6.70	\$7.24	\$7.82
Power		\$2.53	\$2.73	\$2.95	\$3.19	\$3.39
Pulp & Paper / Wood Products		\$0.66	\$0.68	\$0.71	\$0.74	\$0.77
Steel		\$10.68	\$10.89	\$11.11	\$11.33	\$11.56
Stone-Cement		\$5.37	\$5.64	\$5.92	\$6.21	\$6.52
Waste Incinerators		\$1.67	\$1.79	\$1.92	\$2.05	\$2.20
Bags total:		\$71.90	\$74.81	\$77.87	\$81.09	\$84.43

Equipment

Chemical		\$28.39	\$29.61	\$30.88	\$32.21	\$33.59
Food & Grain		\$7.12	\$7.69	\$8.30	\$8.97	\$9.69
Foundries		\$3.59	\$3.69	\$3.79	\$3.90	\$4.00
Metals & Metal Working		\$12.82	\$13.07	\$13.33	\$13.60	\$13.87
Mining		\$1.72	\$1.73	\$1.74	\$1.75	\$1.76
Miscellaneous		\$25.38	\$26.06	\$26.77	\$27.49	\$28.23
Pharmaceutical		\$9.34	\$10.08	\$10.89	\$11.76	\$12.70
Power		\$4.90	\$5.28	\$5.71	\$6.17	\$6.17
Pulp & Paper / Wood Products		\$1.07	\$1.11	\$1.15	\$1.20	\$1.25
Steel		\$16.09	\$16.41	\$16.74	\$17.08	\$17.42
Stone-Cement		\$8.05	\$8.45	\$8.88	\$9.32	\$9.79
Waste Incinerators		\$3.64	\$3.90	\$4.18	\$4.47	\$4.79
Equipment total:		\$122.09	\$127.09	\$132.36	\$137.91	\$143.25

Systems

Chemical		\$62.45	\$65.14	\$67.94	\$70.86	\$73.90
Food & Grain		\$15.66	\$16.92	\$18.27	\$19.73	\$21.31
Foundries		\$7.89	\$8.11	\$8.34	\$8.57	\$8.81

Fabric Filter Industry Forecast (by country)

East Asia

Japan

	(\$ millions)	1999	2000	2001	2002	2003
<u>Metals & Metal Working</u>		\$28.19	\$28.76	\$29.33	\$29.92	\$30.52
<u>Mining</u>		\$3.79	\$3.81	\$3.83	\$3.85	\$3.86
<u>Miscellaneous</u>		\$55.83	\$57.34	\$58.89	\$60.48	\$62.11
<u>Pharmaceutical</u>		\$20.54	\$22.18	\$23.96	\$25.88	\$27.95
<u>Power</u>		\$10.77	\$11.62	\$12.57	\$13.57	\$13.57
<u>Pulp & Paper / Wood Products</u>		\$2.34	\$2.44	\$2.54	\$2.64	\$2.74
<u>Steel</u>		\$35.40	\$36.11	\$36.83	\$37.57	\$38.32
<u>Stone-Cement</u>		\$17.71	\$18.60	\$19.53	\$20.51	\$21.53
<u>Waste Incinerators</u>		\$8.01	\$8.58	\$9.19	\$9.84	\$10.54
Systems total:		\$268.60	\$279.59	\$291.19	\$303.39	\$315.16
Bags total:		\$71.90	\$74.81	\$77.87	\$81.09	\$84.43
Equipment total:		\$122.09	\$127.09	\$132.36	\$137.91	\$143.25
System total:		\$268.60	\$279.59	\$291.19	\$303.39	\$315.16

Fabric Filter Industry Forecast (by country)

East Asia

Malaysia

	(\$ millions)	1999	2000	2001	2002	2003
<u>Bags</u>						
<u>Chemical</u>		\$0.50	\$0.55	\$0.60	\$0.66	\$0.73
<u>Food & Grain</u>		\$0.26	\$0.28	\$0.30	\$0.33	\$0.35
<u>Foundries</u>		\$0.09	\$0.10	\$0.10	\$0.10	\$0.11
<u>Metals & Metal Working</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Mining</u>		\$0.03	\$0.03	\$0.03	\$0.04	\$0.04
<u>Miscellaneous</u>		\$0.94	\$0.97	\$1.00	\$1.03	\$1.06
<u>Pharmaceutical</u>		\$0.18	\$0.19	\$0.21	\$0.22	\$0.24
<u>Power</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Pulp & Paper / Wood Products</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Steel</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Stone-Cement</u>		\$0.74	\$0.78	\$0.81	\$0.86	\$0.90
<u>Waste Incinerators</u>		\$0.05	\$0.06	\$0.07	\$0.08	\$0.09
Bags total:		\$2.79	\$2.95	\$3.13	\$3.31	\$3.51

Equipment

<u>Chemical</u>	\$0.93	\$1.02	\$1.13	\$1.24	\$1.36
<u>Food & Grain</u>	\$0.43	\$0.47	\$0.50	\$0.54	\$0.59
<u>Foundries</u>	\$0.16	\$0.17	\$0.17	\$0.18	\$0.18
<u>Metals & Metal Working</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Mining</u>	\$0.05	\$0.05	\$0.06	\$0.06	\$0.06
<u>Miscellaneous</u>	\$1.53	\$1.58	\$1.63	\$1.67	\$1.72
<u>Pharmaceutical</u>	\$0.29	\$0.31	\$0.34	\$0.36	\$0.39
<u>Power</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Pulp & Paper / Wood Products</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Steel</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Stone-Cement</u>	\$1.11	\$1.16	\$1.22	\$1.28	\$1.35
<u>Waste Incinerators</u>	\$0.18	\$0.20	\$0.23	\$0.26	\$0.29
Equipment total:	\$4.68	\$4.96	\$5.27	\$5.60	\$5.95

Systems

<u>Chemical</u>	\$2.05	\$2.25	\$2.48	\$2.72	\$3.00
<u>Food & Grain</u>	\$0.95	\$1.03	\$1.11	\$1.20	\$1.29
<u>Foundries</u>	\$0.36	\$0.37	\$0.38	\$0.39	\$0.40

Fabric Filter Industry Forecast (by country)

East Asia

Philippines

(\$ millions)	1999	2000	2001	2002	2003
<u>Bags</u>					
<u>Chemical</u>	\$0.40	\$0.43	\$0.47	\$0.50	\$0.54
<u>Food & Grain</u>	\$0.31	\$0.33	\$0.36	\$0.39	\$0.42
<u>Foundries</u>	\$0.11	\$0.11	\$0.12	\$0.12	\$0.12
<u>Metals & Metal Working</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Mining</u>	\$0.17	\$0.18	\$0.19	\$0.20	\$0.20
<u>Miscellaneous</u>	\$1.11	\$1.16	\$1.22	\$1.28	\$1.34
<u>Pharmaceutical</u>	\$0.21	\$0.22	\$0.24	\$0.26	\$0.28
<u>Power</u>	\$0.26	\$0.28	\$0.30	\$0.32	\$0.35
<u>Pulp & Paper / Wood Products</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Steel</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Stone-Cement</u>	\$0.62	\$0.66	\$0.70	\$0.74	\$0.78
<u>Waste Incinerators</u>	\$0.06	\$0.08	\$0.09	\$0.12	\$0.14
Bags total:	\$3.25	\$3.46	\$3.68	\$3.92	\$4.17

Equipment

<u>Chemical</u>	\$0.75	\$0.81	\$0.87	\$0.94	\$1.01
-----------------	--------	--------	--------	--------	--------

<u>Food & Grain</u>	\$0.51	\$0.55	\$0.59	\$0.64	\$0.69
<u>Foundries</u>	\$0.19	\$0.20	\$0.20	\$0.21	\$0.22
<u>Metals & Metal Working</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Mining</u>	\$0.29	\$0.30	\$0.31	\$0.32	\$0.34
<u>Miscellaneous</u>	\$1.80	\$1.89	\$1.98	\$2.08	\$2.18
<u>Pharmaceutical</u>	\$0.34	\$0.36	\$0.39	\$0.42	\$0.46
<u>Power</u>	\$0.50	\$0.53	\$0.60	\$0.62	\$0.62
<u>Pulp & Paper / Wood Products</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Steel</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Stone-Cement</u>	\$0.93	\$0.98	\$1.04	\$1.11	\$1.17
<u>Waste Incinerators</u>	\$0.33	\$0.40	\$0.49	\$0.60	\$0.74
Equipment total:	\$5.65	\$6.03	\$6.49	\$6.95	\$7.42
<u>Systems</u>					
<u>Chemical</u>	\$1.66	\$1.78	\$1.92	\$2.06	\$2.22
<u>Food & Grain</u>	\$1.12	\$1.21	\$1.31	\$1.41	\$1.53
<u>Foundries</u>	\$0.43	\$0.44	\$0.45	\$0.46	\$0.47

Fabric Filter Industry Forecast (by country)

East Asia

Philippines

(\$ millions)	1999	2000	2001	2002	2003
<u>Metals & Metal Working</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Mining</u>	\$0.63	\$0.66	\$0.69	\$0.71	\$0.74
<u>Miscellaneous</u>	\$3.96	\$4.15	\$4.36	\$4.57	\$4.80
<u>Pharmaceutical</u>	\$0.74	\$0.80	\$0.86	\$0.93	\$1.01
<u>Power</u>	\$1.11	\$1.16	\$1.32	\$1.37	\$1.37
<u>Pulp & Paper / Wood Products</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Steel</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Stone-Cement</u>	\$2.04	\$2.17	\$2.30	\$2.43	\$2.58
<u>Waste Incinerators</u>	\$0.73	\$0.89	\$1.09	\$1.33	\$1.62
Systems total:	\$12.42	\$13.27	\$14.29	\$15.29	\$16.33
Bags total:	\$3.25	\$3.46	\$3.68	\$3.92	\$4.17
Equipment total:	\$5.65	\$6.03	\$6.49	\$6.95	\$7.42
System total:	\$12.42	\$13.27	\$14.29	\$15.29	\$16.33

Fabric Filter Industry Forecast (by country)

East Asia

Singapore

(\$ millions)	1999	2000	2001	2002	2003
<u>Bags</u>					
<u>Chemical</u>	\$0.51	\$0.57	\$0.63	\$0.70	\$0.78
<u>Food & Grain</u>	\$0.08	\$0.08	\$0.09	\$0.10	\$0.11
<u>Foundries</u>	\$0.03	\$0.03	\$0.03	\$0.03	\$0.03
<u>Metals & Metal Working</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Mining</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Miscellaneous</u>	\$0.30	\$0.32	\$0.34	\$0.37	\$0.39
<u>Pharmaceutical</u>	\$0.06	\$0.07	\$0.07	\$0.08	\$0.08
<u>Power</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Pulp & Paper / Wood Products</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Steel</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Stone-Cement</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Waste Incinerators</u>	\$0.01	\$0.02	\$0.02	\$0.02	\$0.03
Bags total:	\$1.00	\$1.09	\$1.19	\$1.30	\$1.42
<u>Equipment</u>					
<u>Chemical</u>	\$0.96	\$1.06	\$1.18	\$1.31	\$1.46
<u>Food & Grain</u>	\$0.13	\$0.14	\$0.15	\$0.16	\$0.18
<u>Foundries</u>	\$0.05	\$0.05	\$0.06	\$0.06	\$0.06
<u>Metals & Metal Working</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Mining</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Miscellaneous</u>	\$0.49	\$0.52	\$0.56	\$0.60	\$0.64
<u>Pharmaceutical</u>	\$0.10	\$0.11	\$0.11	\$0.12	\$0.13
<u>Power</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Pulp & Paper / Wood Products</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Steel</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Stone-Cement</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Waste Incinerators</u>	\$0.07	\$0.08	\$0.10	\$0.11	\$0.13
Equipment total:	\$1.80	\$1.97	\$2.16	\$2.37	\$2.60
<u>Systems</u>					
<u>Chemical</u>	\$2.11	\$2.34	\$2.60	\$2.89	\$3.20
<u>Food & Grain</u>	\$0.29	\$0.31	\$0.33	\$0.36	\$0.39
<u>Foundries</u>	\$0.12	\$0.12	\$0.12	\$0.13	\$0.13

Fabric Filter Industry Forecast (by country)

East Asia

Singapore

	(\$ millions)	1999	2000	2001	2002	2003
<u>Metals & Metal Working</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Mining</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Miscellaneous</u>		\$1.08	\$1.15	\$1.23	\$1.32	\$1.41
<u>Pharmaceutical</u>		\$0.22	\$0.23	\$0.25	\$0.27	\$0.29
<u>Power</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Pulp & Paper / Wood Products</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Steel</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Stone-Cement</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Waste Incinerators</u>		\$0.15	\$0.18	\$0.21	\$0.25	\$0.29
Systems total:		\$3.96	\$4.34	\$4.75	\$5.21	\$5.72
Bags total:		\$1.00	\$1.09	\$1.19	\$1.30	\$1.42
Equipment total:		\$1.80	\$1.97	\$2.16	\$2.37	\$2.60
System total:		\$3.96	\$4.34	\$4.75	\$5.21	\$5.72

Fabric Filter Industry Forecast (by country)

East Asia

South Korea

	(\$ millions)	1999	2000	2001	2002	2003
<u>Bags</u>						
<u>Chemical</u>		\$3.05	\$3.30	\$3.57	\$3.87	\$4.19
<u>Food & Grain</u>		\$0.76	\$0.82	\$0.88	\$0.95	\$1.03
<u>Foundries</u>		\$0.47	\$0.49	\$0.50	\$0.51	\$0.53
<u>Metals & Metal Working</u>		\$3.10	\$3.29	\$3.48	\$3.69	\$3.91
<u>Mining</u>		\$0.23	\$0.22	\$0.22	\$0.21	\$0.21
<u>Miscellaneous</u>		\$2.77	\$2.91	\$3.06	\$3.21	\$3.37
<u>Pharmaceutical</u>		\$0.84	\$0.91	\$0.98	\$1.06	\$1.14
<u>Power</u>		\$1.48	\$1.60	\$1.72	\$1.86	\$1.98
<u>Pulp & Paper / Wood Products</u>		\$0.17	\$0.18	\$0.19	\$0.20	\$0.22
<u>Steel</u>		\$4.66	\$4.94	\$5.23	\$5.55	\$5.88
<u>Stone-Cement</u>		\$3.67	\$3.93	\$4.20	\$4.50	\$4.81
<u>Waste Incinerators</u>		\$0.18	\$0.22	\$0.27	\$0.33	\$0.40
Bags total:		\$21.38	\$22.80	\$24.32	\$25.95	\$27.67
<u>Equipment</u>						
<u>Chemical</u>		\$5.71	\$6.19	\$6.70	\$7.26	\$7.86

<u>Food & Grain</u>	\$1.26	\$1.36	\$1.47	\$1.59	\$1.72
<u>Foundries</u>	\$0.82	\$0.85	\$0.87	\$0.89	\$0.92
<u>Metals & Metal Working</u>	\$5.58	\$5.92	\$6.27	\$6.65	\$7.05
<u>Mining</u>	\$0.38	\$0.37	\$0.36	\$0.35	\$0.35
<u>Miscellaneous</u>	\$4.50	\$4.73	\$4.97	\$5.21	\$5.48
<u>Pharmaceutical</u>	\$1.36	\$1.47	\$1.59	\$1.72	\$1.85
<u>Power</u>	\$2.86	\$3.10	\$3.34	\$3.60	\$3.60
<u>Pulp & Paper / Wood Products</u>	\$0.28	\$0.30	\$0.31	\$0.33	\$0.35
<u>Steel</u>	\$7.02	\$7.44	\$7.89	\$8.36	\$8.86
<u>Stone-Cement</u>	\$5.51	\$5.89	\$6.31	\$6.75	\$7.22
<u>Waste Incinerators</u>	\$0.97	\$1.18	\$1.45	\$1.76	\$2.15
Equipment total:	\$36.26	\$38.79	\$41.51	\$44.47	\$47.40

Systems

<u>Chemical</u>	\$12.57	\$13.61	\$14.74	\$15.96	\$17.29
<u>Food & Grain</u>	\$2.78	\$3.00	\$3.24	\$3.50	\$3.78
<u>Foundries</u>	\$1.81	\$1.86	\$1.91	\$1.97	\$2.02

Fabric Filter Industry Forecast (by country)

East Asia

South Korea

(\$ millions)	1999	2000	2001	2002	2003
<u>Metals & Metal Working</u>	\$12.28	\$13.01	\$13.80	\$14.62	\$15.50
<u>Mining</u>	\$0.84	\$0.82	\$0.80	\$0.78	\$0.76
<u>Miscellaneous</u>	\$9.91	\$10.41	\$10.93	\$11.47	\$12.05
<u>Pharmaceutical</u>	\$3.00	\$3.24	\$3.49	\$3.77	\$4.08
<u>Power</u>	\$6.28	\$6.81	\$7.34	\$7.92	\$7.92
<u>Pulp & Paper / Wood Products</u>	\$0.61	\$0.65	\$0.69	\$0.73	\$0.77
<u>Steel</u>	\$15.44	\$16.37	\$17.35	\$18.39	\$19.50
<u>Stone-Cement</u>	\$12.12	\$12.97	\$13.87	\$14.85	\$15.88
<u>Waste Incinerators</u>	\$2.14	\$2.61	\$3.18	\$3.88	\$4.73
Systems total:	\$79.76	\$85.34	\$91.33	\$97.84	\$104.27
Bags total:	\$21.38	\$22.80	\$24.32	\$25.95	\$27.67
Equipment total:	\$36.26	\$38.79	\$41.51	\$44.47	\$47.40
System total:	\$79.76	\$85.34	\$91.33	\$97.84	\$104.27

Fabric Filter Industry Forecast (by country)

East Asia

Taiwan

	(\$ millions)	1999	2000	2001	2002	2003
<u>Bags</u>						
Chemical		\$2.34	\$2.53	\$2.73	\$2.95	\$3.19
Food & Grain		\$0.41	\$0.45	\$0.48	\$0.52	\$0.56
Foundries		\$0.47	\$0.49	\$0.50	\$0.51	\$0.53
Metals & Metal Working		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Mining		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Miscellaneous		\$1.50	\$1.62	\$1.75	\$1.89	\$2.04
Pharmaceutical		\$0.66	\$0.71	\$0.77	\$0.83	\$0.90
Power		\$1.05	\$1.13	\$1.23	\$1.32	\$1.41
Pulp & Paper / Wood Products		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Steel		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Stone-Cement		\$1.28	\$1.33	\$1.39	\$1.44	\$1.50
Waste Incinerators		\$0.04	\$0.05	\$0.06	\$0.07	\$0.09
Bags total:		\$7.77	\$8.31	\$8.91	\$9.55	\$10.22
<u>Equipment</u>						
Chemical		\$4.39	\$4.74	\$5.12	\$5.53	\$5.98
Food & Grain		\$0.69	\$0.75	\$0.81	\$0.87	\$0.94
Foundries		\$0.82	\$0.85	\$0.87	\$0.89	\$0.92
Metals & Metal Working		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Mining		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Miscellaneous		\$2.44	\$2.64	\$2.85	\$3.07	\$3.32
Pharmaceutical		\$1.07	\$1.16	\$1.25	\$1.35	\$1.46
Power		\$2.04	\$2.18	\$2.38	\$2.57	\$2.57
Pulp & Paper / Wood Products		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Steel		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Stone-Cement		\$1.92	\$2.00	\$2.08	\$2.16	\$2.25
Waste Incinerators		\$0.20	\$0.24	\$0.30	\$0.36	\$0.44
Equipment total:		\$13.58	\$14.56	\$15.65	\$16.82	\$17.88
<u>Systems</u>						
Chemical		\$9.67	\$10.44	\$11.27	\$12.18	\$13.15
Food & Grain		\$1.52	\$1.64	\$1.77	\$1.92	\$2.07
Foundries		\$1.81	\$1.86	\$1.91	\$1.97	\$2.02

Fabric Filter Industry Forecast (by country)

East Asia

Taiwan

	(\$ millions)	1999	2000	2001	2002	2003
<u>Metals & Metal Working</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Mining</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Miscellaneous</u>		\$5.37	\$5.80	\$6.26	\$6.76	\$7.30
<u>Pharmaceutical</u>		\$2.36	\$2.55	\$2.76	\$2.98	\$3.21
<u>Power</u>		\$4.49	\$4.80	\$5.23	\$5.65	\$5.65
<u>Pulp & Paper / Wood Products</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Steel</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Stone-Cement</u>		\$4.23	\$4.40	\$4.57	\$4.76	\$4.95
<u>Waste Incinerators</u>		\$0.44	\$0.54	\$0.66	\$0.80	\$0.98
Systems total:		\$29.88	\$32.03	\$34.43	\$37.00	\$39.33
Bags total:		\$7.77	\$8.31	\$8.91	\$9.55	\$10.22
Equipment total:		\$13.58	\$14.56	\$15.65	\$16.82	\$17.88
System total:		\$29.88	\$32.03	\$34.43	\$37.00	\$39.33

Fabric Filter Industry Forecast (by country)

East Asia

Thailand

	(\$ millions)	1999	2000	2001	2002	2003
<u>Bags</u>						
<u>Chemical</u>		\$0.31	\$0.32	\$0.34	\$0.36	\$0.39
<u>Food & Grain</u>		\$0.58	\$0.62	\$0.67	\$0.72	\$0.78
<u>Foundries</u>		\$0.21	\$0.22	\$0.22	\$0.23	\$0.24
<u>Metals & Metal Working</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Mining</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Miscellaneous</u>		\$2.10	\$2.17	\$2.23	\$2.30	\$2.37
<u>Pharmaceutical</u>		\$0.22	\$0.24	\$0.26	\$0.28	\$0.30
<u>Power</u>		\$0.23	\$0.24	\$0.25	\$0.27	\$0.28
<u>Pulp & Paper / Wood Products</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Steel</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Stone-Cement</u>		\$2.48	\$2.66	\$2.84	\$3.04	\$3.25
<u>Waste Incinerators</u>		\$0.12	\$0.14	\$0.17	\$0.19	\$0.23
Bags total:		\$6.25	\$6.61	\$6.99	\$7.40	\$7.83
<u>Equipment</u>						
<u>Chemical</u>		\$0.57	\$0.61	\$0.64	\$0.68	\$0.72

<u>Food & Grain</u>	\$0.96	\$1.04	\$1.12	\$1.21	\$1.30
<u>Foundries</u>	\$0.37	\$0.38	\$0.39	\$0.40	\$0.41
<u>Metals & Metal Working</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Mining</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Miscellaneous</u>	\$3.42	\$3.52	\$3.63	\$3.73	\$3.85
<u>Pharmaceutical</u>	\$0.36	\$0.39	\$0.42	\$0.45	\$0.49
<u>Power</u>	\$0.31	\$0.31	\$0.31	\$0.36	\$0.36
<u>Pulp & Paper / Wood Products</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Steel</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Stone-Cement</u>	\$3.72	\$3.98	\$4.26	\$4.56	\$4.88
<u>Waste Incinerators</u>	\$0.52	\$0.61	\$0.71	\$0.83	\$0.97
Equipment total:	\$10.23	\$10.83	\$11.48	\$12.23	\$12.98

Systems

<u>Chemical</u>	\$1.26	\$1.33	\$1.41	\$1.50	\$1.59
<u>Food & Grain</u>	\$2.11	\$2.28	\$2.46	\$2.66	\$2.87
<u>Foundries</u>	\$0.81	\$0.83	\$0.85	\$0.87	\$0.90

Fabric Filter Industry Forecast (by country)

East Asia

Thailand

(\$ millions)	1999	2000	2001	2002	2003
<u>Metals & Metal Working</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Mining</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Miscellaneous</u>	\$7.52	\$7.74	\$7.98	\$8.21	\$8.46
<u>Pharmaceutical</u>	\$0.79	\$0.85	\$0.92	\$0.99	\$1.07
<u>Power</u>	\$0.69	\$0.69	\$0.69	\$0.79	\$0.79
<u>Pulp & Paper / Wood Products</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Steel</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Stone-Cement</u>	\$8.19	\$8.77	\$9.38	\$10.04	\$10.74
<u>Waste Incinerators</u>	\$1.14	\$1.34	\$1.56	\$1.83	\$2.14
Systems total:	\$22.50	\$23.82	\$25.25	\$26.90	\$28.56
Bags total:	\$6.25	\$6.61	\$6.99	\$7.40	\$7.83
Equipment total:	\$10.23	\$10.83	\$11.48	\$12.23	\$12.98
System total:	\$22.50	\$23.82	\$25.25	\$26.90	\$28.56

Fabric Filter Industry Forecast (by country)

East Asia

Vietnam

(\$ millions)	1999	2000	2001	2002	2003
<u>Bags</u>					
<u>Chemical</u>	\$0.18	\$0.20	\$0.22	\$0.24	\$0.27
<u>Food & Grain</u>	\$0.14	\$0.15	\$0.16	\$0.18	\$0.19
<u>Foundries</u>	\$0.05	\$0.05	\$0.05	\$0.06	\$0.06
<u>Metals & Metal Working</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Mining</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Miscellaneous</u>	\$0.51	\$0.56	\$0.62	\$0.68	\$0.75
<u>Pharmaceutical</u>	\$0.09	\$0.10	\$0.11	\$0.11	\$0.12
<u>Power</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Pulp & Paper / Wood Products</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Steel</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Stone-Cement</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Waste Incinerators</u>	\$0.03	\$0.04	\$0.04	\$0.05	\$0.06
Bags total:	\$1.00	\$1.10	\$1.21	\$1.33	\$1.46
<u>Equipment</u>					
<u>Chemical</u>	\$0.34	\$0.37	\$0.41	\$0.46	\$0.50
<u>Food & Grain</u>	\$0.23	\$0.25	\$0.27	\$0.29	\$0.32
<u>Foundries</u>	\$0.09	\$0.09	\$0.10	\$0.10	\$0.10
<u>Metals & Metal Working</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Mining</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Miscellaneous</u>	\$0.82	\$0.91	\$1.00	\$1.11	\$1.23
<u>Pharmaceutical</u>	\$0.15	\$0.16	\$0.17	\$0.19	\$0.20
<u>Power</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Pulp & Paper / Wood Products</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Steel</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Stone-Cement</u>	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Waste Incinerators</u>	\$0.13	\$0.15	\$0.18	\$0.21	\$0.25
Equipment total:	\$1.76	\$1.94	\$2.14	\$2.35	\$2.59
<u>Systems</u>					
<u>Chemical</u>	\$0.74	\$0.82	\$0.91	\$1.00	\$1.11
<u>Food & Grain</u>	\$0.51	\$0.55	\$0.60	\$0.65	\$0.70
<u>Foundries</u>	\$0.20	\$0.20	\$0.21	\$0.22	\$0.22

Fabric Filter Industry Forecast (by country)

East Asia

Vietnam

	(\$ millions)	1999	2000	2001	2002	2003
<u>Metals & Metal Working</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Mining</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Miscellaneous</u>		\$1.81	\$2.00	\$2.21	\$2.44	\$2.70
<u>Pharmaceutical</u>		\$0.32	\$0.35	\$0.38	\$0.41	\$0.44
<u>Power</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Pulp & Paper / Wood Products</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Steel</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Stone-Cement</u>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<u>Waste Incinerators</u>		\$0.29	\$0.34	\$0.39	\$0.46	\$0.54
Systems total:		\$3.88	\$4.27	\$4.70	\$5.18	\$5.71
Bags total:		\$1.00	\$1.10	\$1.21	\$1.33	\$1.46
Equipment total:		\$1.76	\$1.94	\$2.14	\$2.35	\$2.59
System total:		\$3.88	\$4.27	\$4.70	\$5.18	\$5.71
East Asia	Total:	\$1,560.50	\$1,670.94	\$1,791.38	\$1,922.71	\$2,057.45

FIGURE XII-4C: 1998 TOTAL ASIA Summary (\$ millions)

Industry	Particulate				Dry		Total
	Scrubber	Absorber	Adsorber	Biofilter	Scrubber	Other	
Food	4.76	14.29	3.57	4.76	0.00	0.00	27.38
Forest Products	9.27	38.65	0.77	0.77	0.00	0.00	49.47
Chemical	15.37	153.65	32.02	2.56	5.12	10.24	218.96
Metal	76.66	153.31	13.94	3.48	12.20	8.72	268.30
Surface Coating	11.65	11.65	128.10	1.16	0.00	11.65	164.21
Electronics	7.78	58.37	19.45	0.00	5.83	1.93	93.38
Municipal Wastewater	11.92	59.59	9.93	9.93	0.00	1.99	93.36
Waste Combustion	0.00	58.50	1.60	0.00	18.00	0.00	78.10
Other	37.26	58.23	34.93	2.32	11.65	9.32	153.72
TOTAL	174.67	606.25	244.32	24.99	52.80	43.86	1,146.88

801.42 The Mcllvaine Company

FIGURE XII-4D: 1999 TOTAL ASIA Summary (\$ millions)

Industry	Particulate				Dry		Total
	Scrubber	Absorber	Adsorber	Biofilter	Scrubber	Other	
Food	5.27	15.84	3.96	5.27	0.00	0.00	30.33
Forest Products	10.16	42.34	0.85	0.85	0.00	0.00	54.20
Chemical	17.06	170.64	35.56	2.84	5.69	11.38	243.17
Metal	84.94	169.87	15.44	3.86	13.52	9.66	297.29
Surface Coating	12.88	12.88	141.65	1.29	0.00	12.88	181.58
Electronics	9.73	72.97	24.32	0.00	7.29	2.42	116.72
Municipal Wastewater	13.05	65.23	10.87	10.87	0.00	2.18	102.19
Waste Combustion	0.00	70.20	1.90	0.00	21.60	0.00	93.70
Other	41.20	64.39	38.63	2.57	12.88	10.31	169.98
TOTAL	194.30	684.37	273.17	27.54	60.98	48.82	1,289.18

801.43 The Mcllvaine Company

FIGURE XII-4E: 2000 TOTAL ASIA Summary (\$ millions)

Industry	Particulate				Dry		Total
	Scrubber	Absorber	Adsorber	Biofilter	Scrubber	Other	
Food	5.84	17.55	4.39	5.84	0.00	0.00	33.61
Forest Products	11.13	46.40	0.93	0.93	0.00	0.00	59.39
Chemical	18.95	189.52	39.49	3.16	6.32	12.64	270.07
Metal	94.13	188.25	17.11	4.27	14.98	10.70	329.46
Surface Coating	14.24	14.24	156.65	1.42	0.00	14.24	200.81
Electronics	11.68	87.56	29.18	0.00	8.75	2.90	140.07
Municipal Wastewater	14.28	71.42	11.90	11.90	0.00	2.38	111.88
Waste Combustion	0.00	70.20	1.90	0.00	21.60	0.00	93.70
Other	45.56	71.21	42.72	2.84	14.24	11.40	187.98
TOTAL	215.83	756.35	304.27	30.36	65.89	54.27	1,426.97

801.44 The Mcllvaine Company

FIGURE XII-4F: 2001 TOTAL ASIA Summary (\$ millions)

Industry	Particulate		Dry				Total
	Scrubber	Absorber	Adsorber	Biofilter	Scrubber	Other	
Food	6.47	19.44	4.86	6.47	0.00	0.00	37.24
Forest Products	12.20	50.85	1.02	1.02	0.00	0.00	65.09
Chemical	21.05	210.49	43.86	3.51	7.02	14.03	299.96
Metal	104.33	208.64	18.97	4.74	16.60	11.86	365.14
Surface Coating	15.75	15.75	173.26	1.57	0.00	15.75	222.09
Electronics	14.01	105.07	35.01	0.00	10.50	3.48	168.08
Municipal Wastewater	15.64	78.20	13.03	13.03	0.00	2.61	122.51
Waste Combustion	0.00	81.90	2.20	0.00	25.20	0.00	109.30
Other	50.39	78.76	47.25	3.14	15.75	12.61	207.91
TOTAL	239.85	849.11	339.45	33.48	75.07	60.35	1,597.32

801.45 The Mcllvaine Company

Figure X-1

Country	1000 MW
Australia	2
China	30
India	10
Indonesia	5
Japan	12
Pakistan	5
Philippines	6
South Korea	15
Taiwan	10
Thailand	6
Others	5
TOTAL	106

800.40 Mcllvaine Company

FIGURE X-2a: ASIAN FGD Systems Orders (\$ millions)

Order Start Up		Total MW	System Revenue	Carbon Steel	Corrosion Resistant Materials	Pumps/ Valves	Fans/Dampers/ Expansion Joints	Liquid/ Solid Systems
Year	Year	(thousands)	----- (\$ millions)-----					
1997	2000	7.0	1050.00	95.20	122.50	17.71	48.44	12.46
1998	2001	7.0	1050.00	95.20	122.50	17.71	48.44	12.46
1999	2002	8.0	1200.00	108.80	140.00	20.24	55.36	14.24
2000	2003	8.0	1200.00	108.80	140.00	20.24	55.36	14.24
2001	2004	9.0	1350.00	122.40	157.50	22.77	62.28	16.02
2002	2005	9.0	1350.00	122.40	157.50	22.77	62.28	16.02
2003	2006	10.0	1500.00	136.00	175.00	25.30	69.20	17.80
2004	2007	10.0	1500.00	136.00	175.00	25.30	69.20	17.80
2005	2008	11.0	1650.00	149.60	192.50	27.83	76.12	19.58
2006	2009	13.0	1950.00	176.80	227.50	32.89	89.96	23.14

800.22 The Mcllvaine Company

FIGURE A-20: ASIAN System Revenue

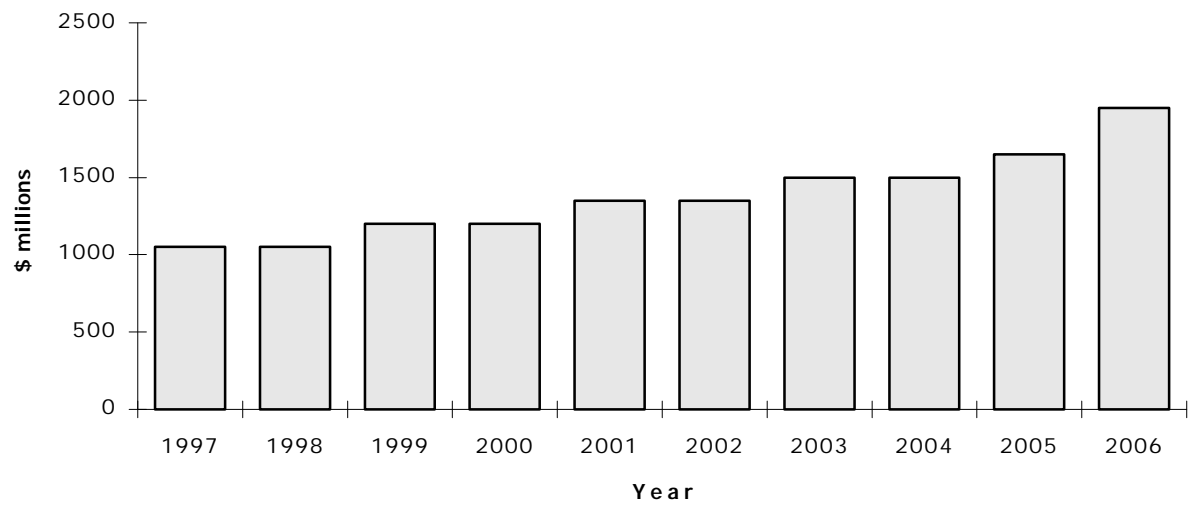


FIGURE X-3: ASIAN Utility FGD Renovations

Year	20-year Old Units (MW thousands)	Net Units Renovated * d *	Renovation Expense (\$ millions)
1996	5.00	4.00	240.00
1997	5.00	4.00	240.00
1998	2.00	1.60	96.00
1999	0.00	0.00	0.00
2000	0.00	0.00	0.00
2001	1.00	0.80	48.00
2002	1.00	0.80	48.00
2003	2.00	1.60	96.00
2004	2.00	1.60	96.00
2005	2.00	1.60	96.00
2006	0.00	0.00	0.00

* 80% renovated; 20% retired

800.23 The McIlvaine Company

FIGURE X-4: ASIAN System Supplier
Orders (\$ millions)

Year	New Systems	Renovations	Total
1997	1050	240	1290
1998	1050	96	1146
1999	1200	0	1200
2000	1200	0	1200
2001	1350	48	1398
2002	1350	48	1398
2003	1500	96	1596
2004	1500	96	1596
2005	1650	96	1746
2006	1950	0	1950

800.24 The McIlvaine Company

FIGURE X-5a: ASIAN Annual Retrofit FGD Costs (\$ millions)

			Utility	Carbon	Corrosion	Pumps/	Fans/Dampers/	Liquid/Solid	
Year	New	Total	Costs	Steel	Resistant	Valves	Expansion Joints	Separation	
--(MW thousands)--			----- (\$ millions) -----						
1997	4.0	48.0	2,016.00	25.92		43.20	21.60	49.44	12.96
1998	12.0	60.0	2,520.00	32.40		54.00	27.00	61.80	16.20
1999	8.0	68.0	2,856.00	36.72		61.20	30.60	70.04	18.36
2000	7.0	75.0	3,150.00	40.50		67.50	33.75	77.25	20.25
2001	7.0	82.0	3,444.00	44.28		73.80	36.90	84.46	22.14
2002	8.0	90.0	3,780.00	48.60		81.00	40.50	92.70	24.30
2003	8.0	98.0	4,116.00	52.92		88.20	44.10	100.94	26.46
2004	9.0	107.0	4,494.00	57.78		96.30	48.15	110.21	28.89
2005	9.0	116.0	4,872.00	62.64		104.40	52.20	119.48	31.32
2006	10.0	126.0	5,292.00	68.04		113.40	56.70	129.78	34.02

10

800.25 The McIlvaine Company

FIGURE IX-9: Summary of Catalytic Oxidizers - East Asia (\$ millions)

Year	Surface		Forest		Other				Total
	Transportation	Coating	Food	Products	Chemicals	Electronics	Municipal	Industries	
1995	2.06	13.99	5.56	0.48	10.98	5.88	14.53	11.99	65.47
1996	2.27	15.53	6.18	0.53	12.21	7.06	15.98	13.31	73.06
1997	2.49	17.24	6.88	0.58	13.58	7.83	17.58	14.77	80.95
1998	2.74	19.13	7.65	0.64	15.10	9.40	19.34	16.40	90.39
1999	3.02	21.24	8.50	0.70	16.79	11.75	21.27	18.20	101.47
2000	3.32	23.57	9.45	0.77	18.67	14.10	23.40	20.20	113.49
2001	3.65	26.17	10.5	0.85	20.76	16.92	25.74	22.43	127.02
			1						

601.23 The Mcllvaine Company

FIGURE IX-10: Summary of Catalytic Oxidizers - West Asia (\$ millions)

Year	Surface		Forest					Other	Total
	Transportation	Coating	Food	Products	Chemicals	Electronics	Municipal	Industries	
1995	0.27	2.47	0.83	0.05	0.68	0.25	2.03	2.12	8.70
1996	0.29	2.67	0.89	0.05	0.73	0.30	2.13	2.29	9.36
1997	0.31	2.88	0.96	0.06	0.79	0.33	2.24	2.47	10.05
1998	0.34	3.11	1.04	0.06	0.85	0.40	2.35	2.67	10.82
1999	0.37	3.36	1.12	0.06	0.91	0.50	2.47	2.88	11.67
2000	0.40	3.63	1.20	0.06	0.99	0.60	2.59	3.11	12.58
2001	0.43	3.92	1.30	0.07	1.06	0.72	2.72	3.36	13.58

601.24 The Mcllvaine Company

FIGURE IX-11: Summary of Catalytic Oxidizers - Total Asia (\$ millions)

Year	Transportation	Surface Coating	Food Products	Forest Chemicals	Electronics	Municipal	Other Industries	Total	
1995	2.33	16.46	6.39	0.53	11.66	6.13	16.56	14.11	74.17
1996	2.56	18.20	7.08	0.58	12.94	7.36	18.11	15.60	82.42
1997	2.81	20.12	7.84	0.64	14.37	8.17	19.82	17.25	91.00
1998	3.08	22.24	8.68	0.70	15.95	9.80	21.69	19.07	101.21
1999	3.38	24.60	9.62	0.76	17.70	12.25	23.74	21.09	113.14
2000	3.71	27.20	10.6	0.84	19.65	14.70	25.99	23.32	126.07
2001	4.08	30.09	11.8	0.92	21.82	17.64	28.46	25.79	140.60

601.25 The Mcllvaine Company

FIGURE IX-20: Summary of Thermal - East Asia (\$ millions)

Year	Transportation	Surface Coating	Food Products	Forest Chemicals	Electronics	Municipal	Other Industries	Total	
1995	4.87	13.63	2.99	2.08	13.13	10.13	6.52	17.22	70.57
1996	5.36	15.13	3.32	2.29	14.60	12.16	7.17	19.11	79.14
1997	5.89	16.79	3.70	2.52	16.24	13.49	7.89	21.22	87.74
1998	6.48	18.64	4.11	2.77	18.05	16.19	8.68	23.55	98.48
1999	7.13	20.69	4.57	3.05	20.08	20.24	9.55	26.14	111.44
2000	7.84	22.97	5.08	3.35	22.32	24.29	10.50	29.02	125.37
2001	8.63	25.49	5.65	3.68	24.83	29.15	11.55	32.21	141.19

601.34 The Mcllvaine Company

FIGURE IX-21: Summary of Thermal - West Asia (\$ millions)

Year	Transportation	Surface Coating	Food Products	Forest Products	Chemicals	Electronics	Municipal	Other Industries	Total
1995	0.63	2.41	0.45	0.23	0.82	0.43	0.91	3.05	8.93
1996	0.68	2.60	0.48	0.24	0.88	0.52	0.96	3.29	9.66
1997	0.73	2.81	0.52	0.25	0.95	0.57	1.00	3.56	10.41
1998	0.79	3.04	0.56	0.27	1.02	0.69	1.05	3.84	11.27
1999	0.86	3.28	0.61	0.28	1.10	0.86	1.11	4.15	12.24
2000	0.93	3.54	0.65	0.29	1.19	1.03	1.16	4.48	13.27
2001	1.00	3.82	0.70	0.31	1.28	1.24	1.22	4.84	14.41

601.35 The
McIlvaine
Company

FIGURE IX-22: Summary of Thermal - Total Asia (\$ millions)

Year	Transportation	Surface Coating	Food Products	Forest Products	Chemicals	Electronics	Municipal	Other Industries	Total
1995	5.50	16.04	3.44	2.31	13.95	10.56	7.43	20.27	79.50
1996	6.04	17.73	3.81	2.53	15.48	12.67	8.13	22.41	88.80
1997	6.63	19.60	4.22	2.77	17.19	14.07	8.89	24.77	98.14
1998	7.28	21.68	4.67	3.03	19.08	16.88	9.73	27.39	109.74
1999	7.99	23.97	5.18	3.32	21.18	21.10	10.65	30.29	123.68
2000	8.77	26.51	5.74	3.64	23.51	25.32	11.66	33.50	138.65
2001	9.63	29.32	6.36	3.99	26.10	30.38	12.77	37.05	155.60

601.36 The
McIlvaine
Company

FIGURE IX-31: Summary of RTO - East Asia (\$ millions)

Year	Transportation	Surface Coating	Food Products	Forest Products	Chemicals	Electronics	Municipal	Other Industries	Total
1995	10.93	21.79	4.26	13.79	19.94	21.63	12.38	25.87	130.59
1996	12.35	24.62	4.81	15.44	22.53	25.96	13.99	29.23	148.94
1997	13.96	27.82	5.44	17.30	25.46	28.81	15.81	33.03	167.63
1998	15.77	31.44	6.15	19.37	28.77	34.57	17.86	37.33	191.27
1999	17.82	35.53	6.95	21.70	32.51	43.22	20.19	42.18	220.09
2000	20.14	40.15	7.85	24.30	36.74	51.86	22.81	47.66	251.51
2001	22.76	45.37	8.87	27.22	41.51	62.23	25.77	53.86	287.59

601.45 The Mclvaine Company

FIGURE IX-32: Summary of RTO - West Asia (\$ millions)

Year	Transportation	Surface Coating	Food Products	Forest Products	Chemicals	Electronics	Municipal	Other Industries	Total
1995	1.41	3.85	0.63	1.53	1.24	0.91	1.73	4.58	15.88
1996	1.52	4.16	0.68	1.62	1.34	1.09	1.87	4.95	17.23
1997	1.64	4.49	0.73	1.72	1.45	1.21	2.02	5.34	18.61
1998	1.78	4.85	0.79	1.82	1.56	1.45	2.18	5.77	20.21
1999	1.92	5.24	0.86	1.93	1.69	1.82	2.35	6.23	22.03
2000	2.07	5.66	0.93	2.05	1.82	2.18	2.54	6.73	23.98
2001	2.24	6.11	1.00	2.17	1.97	2.62	2.75	7.27	26.12

601.46 The Mclvaine Company

FIGURE IX-33: Summary of RTO - Total Asia (\$ millions)

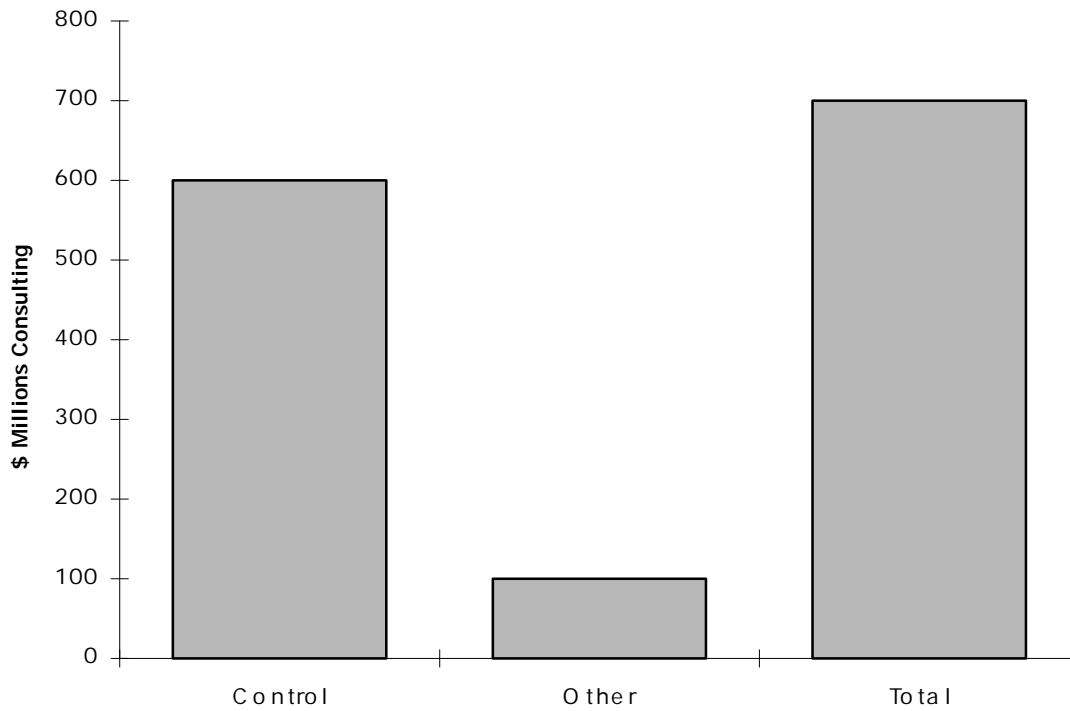
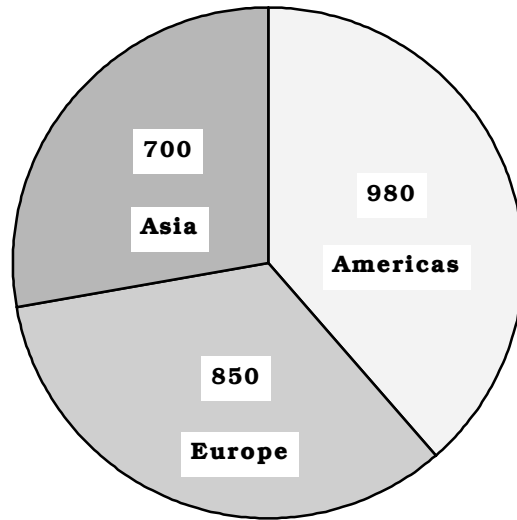
Year	Transportation	Surface Coating	Food Products	Forest Chemicals	Electronics	Municipal	Other Industries	Total	
1995	12.34	25.64	4.89	15.32	21.18	22.54	14.11	30.45	146.47
1996	13.87	28.78	5.49	17.07	23.87	27.05	15.86	34.18	166.17
1997	15.60	32.31	6.17	19.02	26.91	30.02	17.83	38.38	186.24
1998	17.55	36.29	6.94	21.20	30.33	36.03	20.04	43.10	211.48
1999	19.74	40.77	7.80	23.63	34.20	45.03	22.54	48.41	242.12
2000	22.21	45.80	8.77	26.35	38.56	54.04	25.35	54.39	275.48
2001	24.99	51.48	9.87	29.39	43.48	64.85	28.52	61.13	313.71

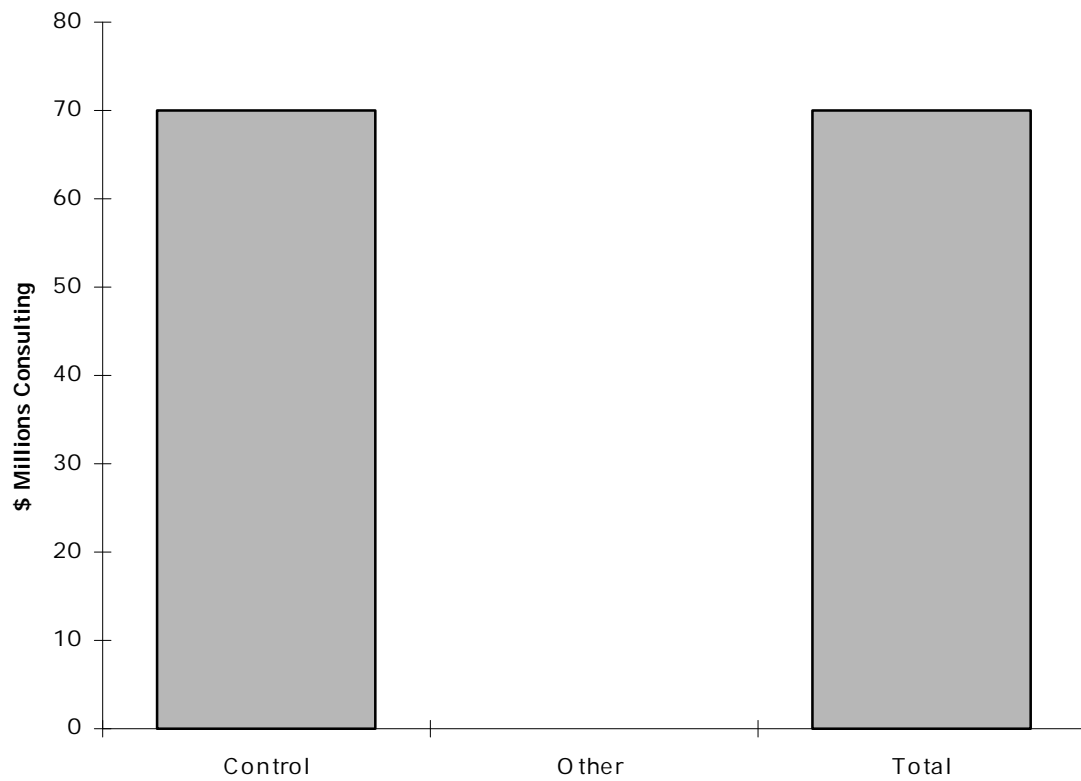
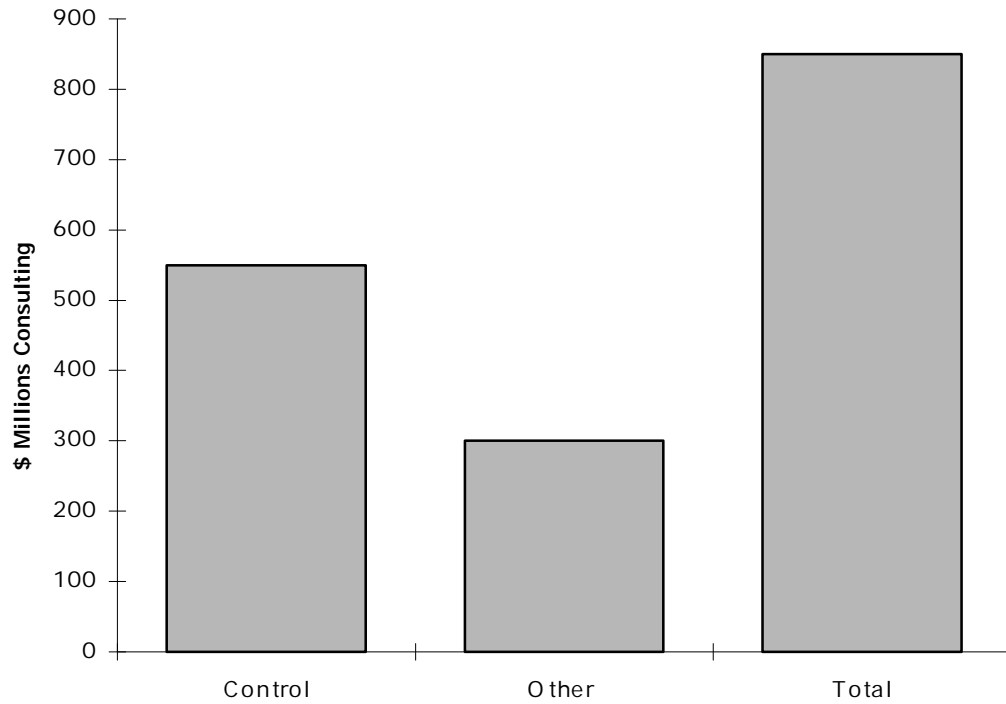
601.47 The
McIlvaine
Company

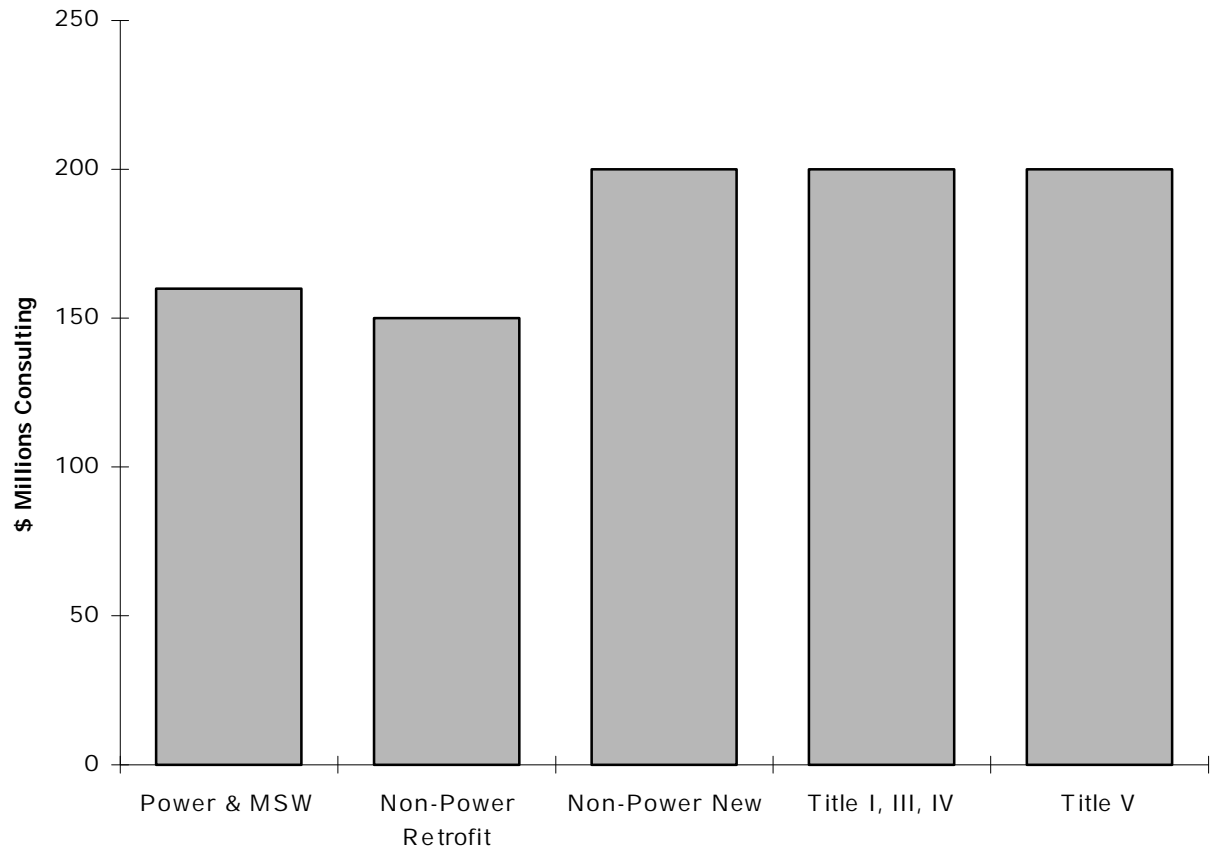
Figure 1. 1995 World Air Pollution Systems and Air Consulting Market

Sector	Air Pollution Systems \$ Millions Total	\$ Millions Consulting
U.S.		
Power & MSW	1,600	160
Non-Power Retrofit	1,500	150
Non-Power New	2,000	200
Sub Total	5,100	
Title I, III, IV		200
Title V		200
Sub Total		910
Europe		
Control	5,500	550
Other		300
Total		850
Asia		
Control	6,000	600
Other		100
Total		700
Americas (Non-U.S.)		
Control	700	70
Other		
Total		70
WORLD	17,300	2,530

**1995 Air Consulting Revenues
\$Millions**







End Notes

ⁱ Figure I-7, Precipitators (Wet Dry) by Location Totals - \$ millions

Electrostatic Precipitator World Markets – 1999-2004, Chapter I

World Air Pollution Market by Industry 2000

Air Pollution Management, February 2000 - #203.

ⁱⁱ Precipitators (Wet Dry) by Location - \$ millions in Asia

Electrostatic Precipitator World Markets – 1999-2004, Chapter XIII

ⁱⁱⁱ Fabric Filter Industry Forecast (by country) in East Asia

World Fabric Filter and Element Market 1999-2004, Chapter XIII

^{iv} Figures XII-4C, 4D, 4E and 4F – 1998, 1999, 2000 and 2001 - Total Asia Summary (\$ millions)

Scrubber/Adsorber/Biofilter World Markets 1997-2001

^v Chapter X – Asian Forecast

Figure X-1- Asian FGD 10-Year Forecast (1,000 MW)

Figure X-2a - Asian FGD Systems Orders (\$ millions)

Figure X-2b - Asian System Revenue, X-3 Asian Utility FGD Renovations

Figure X-4 - Asian System Supplier Orders (\$ millions)

Figure X-5a - Asian Annual Retrofit FGD Costs (\$ millions)

FGD World Markets 1997-2001

^{vi} Figure IX-9 - Summary of Catalytic Oxidizers – East Asia (\$ millions)

Figure IX-10 - Summary of Catalytic Oxidizers – West Asia (\$ millions)

Figure IX-11 - Summary of Catalytic Oxidizers – Total Asia (\$ millions)

Figure IX-20 - Summary of Thermal – East Asia (\$ millions)

Figure IX-21 - Summary of Thermal – West Asia (\$ millions)

Figure IX-22 - Summary of Thermal – Total Asia (\$ millions)

Figure IX-31 - Summary of RTO – East Asia (\$ millions)

Figure IX-32 - Summary of RTO – West Asia (\$ millions)

Figure IX-33 - Summary of RTO – Total Asia (\$ millions)

Thermal/Catalytic World Markets 1997-2001, Volume III, Chapter IX

^{vii} 2001 (\$ millions) Yearly Totals

Air Pollution Management, May 1999 - #194

^{viii} Figure XIII-6 Overall World Summary (\$ millions)

Air Pollution Monitoring and Sampling World Markets, Chapter XIII

^{ix} World Air Consulting Market

Figure 1 – 1995 World Air Consulting Market

Figure 2 – United States

Figure 3 – Europe

Figure 4 – Asia

Figure 5 – Americas (Non-U.S.)
Figure 6 - World
Air Pollution Management, May 1995, #146